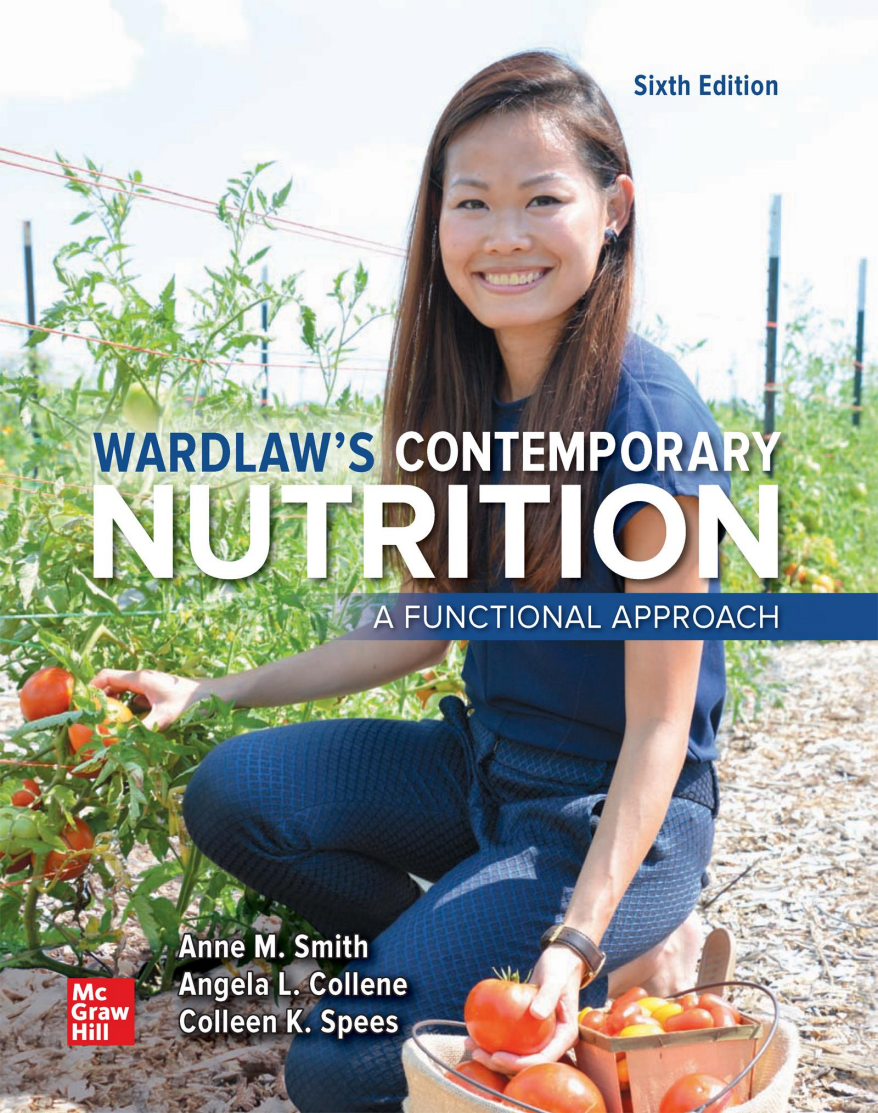

Sixth Edition
WARDLAW'S CONTEMPORARY
NUTRITION
A FUNCTIONAL APPROACH
Anne M. Smith
Angela L. Collene
Colleen K. Spees
Mc
Graw
Hill

WARDLAW'S CONTEMPORARY NUTRITION: A FUNCTIONAL APPROACH,
SIXTH EDITION

This book is printed on acid-free paper.

1 2 3 4 5 6 7 8 9 LWI 21 20

ISBN 978-1-260-25901-8 (bound edition)
MHID 1-260-25901-3 (bound edition)
ISBN 978-1-260-46498-6 (loose-leaf edition)
MHID 1-260-46498-9 (loose-leaf edition)

Portfolio Manager: *Lauren Vondra*
Product Developer: *Darlene Schueller*
Marketing Manager: *James Connely*
Content Project Managers: *Ann Courtney/Brent dela Cruz*
Buyer: *Susan K. Culbertson*
Designer: *Egzon Shaqiri*
Content Licensing Specialist: *Abbey Jones*
Front Cover Image/Back Cover Image: *Mary-Jon Ludy/Briana Zabala*
Compositor: *MPS Limited*

Library of Congress Cataloging-in-Publication Data

Wardlaw, Gordon M., author. | Smith, Anne M., 1955- author. |
Collene, Angela, author. | Spees, Colleen K., author.
Wardlaw's contemporary nutrition : a functional approach / Anne M. Smith, PhD, RDN, LD, Department of Human Sciences, College of Education and Human Ecology, The Ohio State University, Angela L. Collene, MS, RDN, LD, Department of Human Sciences, College of Education and Human Ecology, The Ohio State University, Colleen K. Spees, PhD, MEd, RDN, LD, FAND, Division of Medical Dietetics and Health Sciences, College of Medicine, The Ohio State University.
Contemporary nutrition
Sixth edition. | New York : McGraw-Hill Education, [2021] |
Includes bibliographical references and index.
LCCN 2019031558 (print) | LCCN 2019031559 (ebook) | ISBN 9781260259018 (hardcover) | ISBN 9781260465051 (epub)
LCSH: Nutrition.
LCC QP141 .W377 2021 (print) | LCC QP141 (ebook) | DDC 612.3—dc23
LC record available at https://lccn.loc.gov/2019031558
LC ebook record available at https://lccn.loc.gov/2019031559

mheducation.com/highered

Brief Contents





Breakfast: Alexis Joseph/McGraw-Hill Education; bowl of dietary fiber: Marilyn Barbone/Shutterstock; micronutrients/phytochemicals: Alexis Joseph/McGraw-Hill Education; swimmer: Erik Isakson/Blend Images LLC; pregnant woman: Stockbyte/Getty Images

Mc Graw Hill Education
5011333

Dear Students,

Welcome to the fascinating world of nutrition! Nutrition is our favorite area of science because it is so relevant—we all eat and drink several times a day, and the choices we make can have a dramatic influence on health. The science of nutrition, however, can seem a bit confusing. "Good nutrition" is a moving target; different authorities have different ideas of how we should eat, and nutrition recommendations are subject to change! Also, there are so many choices. The average supermarket carries over 40,000 food and beverage products, and often, the most aggressively marketed items are not the healthiest. Furthermore, as a nation, we eat many of our meals and snacks away from home. When we eat foods that someone else has prepared for us, we surrender control over what is in our food, where the food came from, and how much of it goes on our plates. Undoubtedly, you are interested in what you should be eating and how the food you eat affects you.

Wardlaw's Contemporary Nutrition: A Functional Approach *is designed to accurately convey changing and seemingly conflicting messages to all students. Our students commonly have misconceptions about nutrition, and many have a limited background in biology or chemistry. We teach complex scientific concepts at a level that will enable you to apply the material to your own life.*

The sixth edition of ***Wardlaw's Contemporary Nutrition: A Functional Approach*** *has been written to help you make informed choices about the food you eat. We have emphasized choosing whole, minimally processed foods and hope you enjoy our newest feature, "Farm to Fork," which gives you practical advice for incorporating fruits and vegetables into your dietary pattern, from the ground up! We will take you through explanations of the nutrients in food and their relationship to health and will also make you aware of the multitude of other factors that drive food choices. To guide you, we refer to evidence-based research and resources throughout the book. With this information at your fingertips, you will be well equipped to make your own informed choices about what and how much to eat. There is much to learn, so let's get started!*

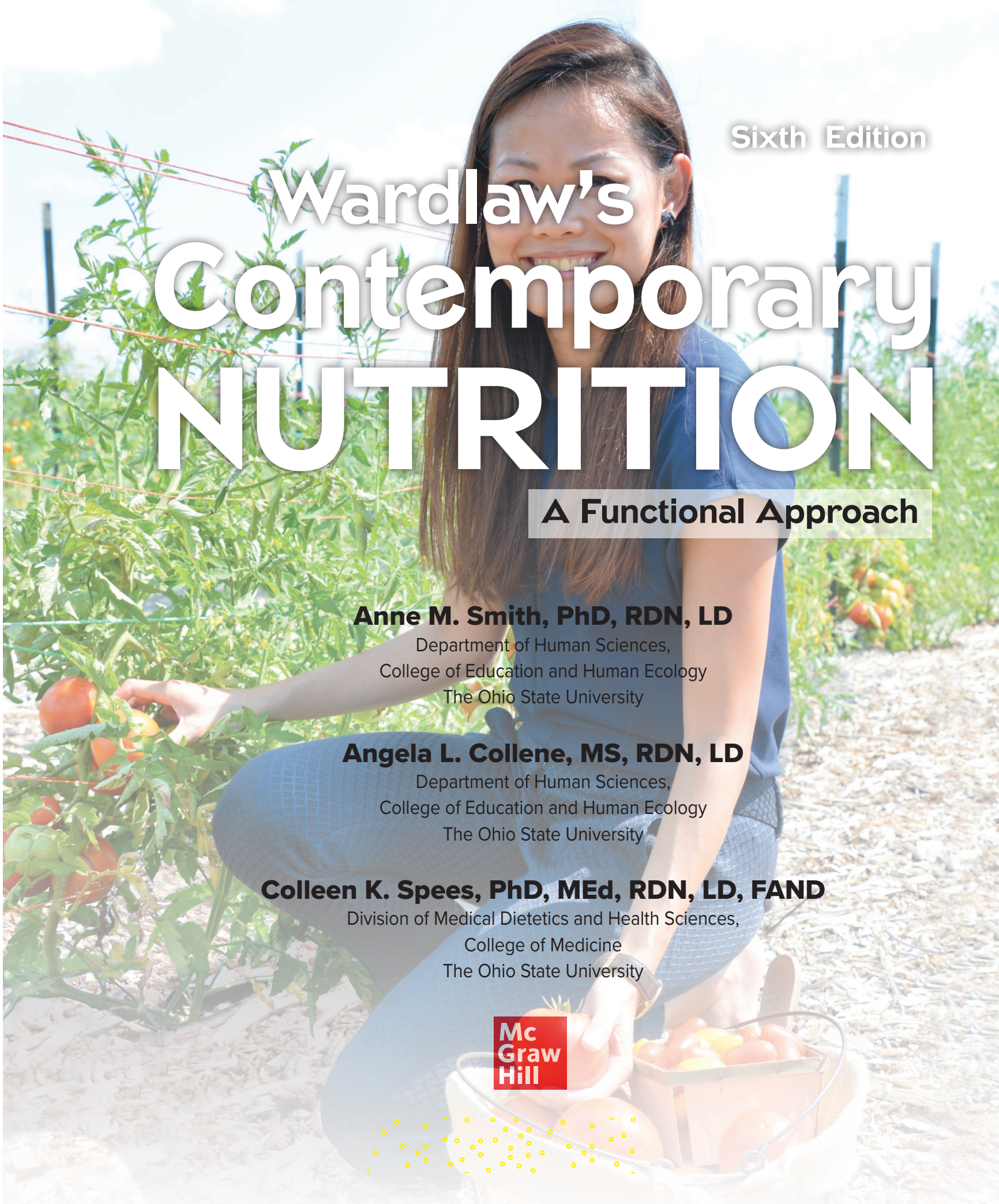
Anne Smith
Angela Collene
Colleen Spees

About the Cover

The Hope Gardens are living research, teaching, and service-learning laboratories at The Ohio State University, academic home of the author team. Featured on the front cover is one of our previous nutrition students harvesting tomatoes from the Hope Gardens; she is currently serving as an RDN in Singapore. In this edition, we emphasize the importance of sustainable and local farming by updating our popular "Farm to Fork" feature, providing additional suggestions and infographics promoting plant-based dietary patterns, and highlighting national expert contributors to our "Ask the RDN" feature. Like our beautiful gardens, we thrive when we are planted in a nurturing environment rooted in science.

Briana Zabala

The authors, Anne Smith, Colleen Spees, and Angela Collene, at the Hope Gardens



Sixth Edition

Wardlaw's Contemporary NUTRITION

A Functional Approach

Anne M. Smith, PhD, RDN, LD
Department of Human Sciences,
College of Education and Human Ecology
The Ohio State University

Angela L. Collene, MS, RDN, LD
Department of Human Sciences,
College of Education and Human Ecology
The Ohio State University

Colleen K. Spees, PhD, MEd, RDN, LD, FAND
Division of Medical Dietetics and Health Sciences,
College of Medicine
The Ohio State University

Mc Graw Hill

About the Authors

Monty Soungpradith/Open Image Studio LLC

ANNE M. SMITH, PhD, RDN, LD, is an associate professor emeritus at The Ohio State University. She was the recipient of the Outstanding Teacher Award from the College of Human Ecology, the Outstanding Dietetic Educator Award from the Ohio Dietetic Association, the Outstanding Faculty Member Award from the Department of Human Nutrition, and the Distinguished Service Award from the College of Education and Human Ecology for her commitment to undergraduate education in nutrition. Dr. Smith's research in the area of vitamin and mineral metabolism has appeared in prominent nutrition journals, and she was awarded the Research Award from the Ohio Agricultural Research and Development Center. She is a member of the American Society for Nutrition and the Academy of Nutrition and Dietetics.

Tim Klontz, Klontz Photography

ANGELA L. COLLENE, MS, RDN, LD, began her career at her alma mater, The Ohio State University, as a research dietitian for studies related to diabetes and aging. Other professional experiences include community nutrition lecturing and counseling, owner of a personal chef business, and many diverse and rewarding science writing and editing projects. Her interests include novel approaches to glycemic control, weight management, and—quite predictably for the mother of three little girls—maternal and child nutrition. Mrs. Collene currently teaches nutrition at The Ohio State University. She is a member of the Academy of Nutrition and Dietetics.

Ralphoto Studio

COLLEEN K. SPEES, PhD, MEd, RDN, LD, FAND, is an associate professor at The Ohio State University College of Medicine. She earned her doctorate at Ohio State with a research focus on Nutritional Genomics and Cancer and her master's degree in Exercise Science and Health Promotion from Vanderbilt University. Her primary focus of teaching and research involves interventions aimed at providing optimal nutrition for vulnerable populations (http://go.osu.edu/hope). In addition to teaching Nutritional Genomics and Evidence-Based Medicine, she is the recipient of several national awards from the Academy of Nutrition and Dietetics. They include the Distinguished Practice Award, Award for Excellence in Oncology Nutrition Research, Outstanding Dietetic Educator Award, and the Top Innovator in Education. Dr. Spees is also a recognized Fellow of the Academy of Nutrition and Dietetics.

Acknowledgments

It is because of the tireless efforts of a cohesive team of talented professionals that we can bring you the sixth edition of *Wardlaw's Contemporary Nutrition: A Functional Approach*. We consider ourselves massively blessed to work with the top-notch staff at McGraw-Hill Education. We thank Lauren Vondra, Portfolio Manager, for her leadership of our team. We are immensely grateful to our award-winning Product Developer, Darlene Schueller, who strategically led the day-to-day efforts of the entire editorial team. We especially appreciate her longevity over many editions of the *Contemporary Nutrition* products and value her keen eye for detail, strong work ethic, and organizational expertise. We are grateful to our Content Project Manager, Ann Courtney, and her staff for their patience and careful coordination of the numerous production efforts needed to create the very appealing and accurate sixth edition. We thank Brent dela Cruz, our Assessment Content Project Manager, for his efforts and assistance. We appreciate the meticulous work of our copyeditor, Heath Lynn Silberfeld; proofreaders, Jennifer Grubba and David Heath; and our Content Licensing Specialist, Abbey Jones. We thank our Designer, Egzon Shaqiri, who ensured that every aspect of our work is visually appealing—not just on the printed page but also in a variety of digital formats. Finally, we are indebted to our colleagues, friends, and families for their constant encouragement, honest feedback, and shared passion for the science of nutrition.

Reviewers

In the preparation of each edition, we have been guided by the collective wisdom of reviewers who are excellent teachers. They represent experience in community colleges, liberal arts colleges, institutions, and universities. We have followed their recommendations, while remaining true to our overriding goal of writing a readable, student-centered text.

Jill Bryan
Dixie State University

Priscilla Burrow Crocker
University of Colorado Denver

Donielle Dominguez
Front Range Community College

Michelle M. Donovan
Montgomery County Community College

Jennifer Frere
Cuesta College

Virginia B. Gray
California State University Long Beach

Merilee Larsen
Utah Valley University

Heather Lupkey
Truckee Meadows Community College

Stephanie Nunes
Cuesta Community College

Heather Williams
Truckee Meadows Community College

Stacie L. Wing-Gaia
University of Utah

"Ask the RDN" Contributors

We are grateful to our reputable and talented RDN colleagues who authored several new "Ask the RDN" features in this edition. It was exciting to share the spotlight and include their evidence-based expertise and applicable, down-to-earth recommendations. Many thanks to the following:

Leslie Bonci, MPH, RDN, CSSD, LDN
Zachari Breeding, MS, RDN, LDN, FAND
Karen K. Collins, MS, RDN, CDN, FAND
Alexis Joseph, MS, RDN, LD
Sally Kuzemchak, MS, RDN
Leah McGrath, RDN, LDN
Chris Vogliano, MS, RDN

Student-Informed Reviews

We are very pleased to have been able to incorporate real student data points and input, derived from thousands of our SmartBook® users, to help guide our revision. SmartBook heat maps provided a quick visual snapshot of usage of portions of the text and the relative difficulty students experienced in mastering the content. With these data, we were able to hone not only our text content but also the SmartBook probes.

With the sixth edition of *Wardlaw's Contemporary Nutrition: A Functional Approach* we remember its founding author, Gordon M. Wardlaw. Dr. Wardlaw had a passion for the science of nutrition and the research that supports it and demonstrated an exceptional ability to translate scientific principles into practical knowledge. This skill is what made his book truly "contemporary." He was tireless when it came to staying current and relevant to a changing world. It has been a privilege for all of us to join Dr. Wardlaw as coauthors of this textbook. For Anne Smith, he was an extraordinary colleague, mentor, and friend. Angela Collene was blessed to have been one of his graduate students at The Ohio State University, where she first began to assist with revisions to his books. Colleen Spees was a student in Dr. Wardlaw's first nutrition class at The Ohio State University and now holds his previous tenured faculty position. Like so many other students, colleagues, and friends, we remember Dr. Wardlaw as a source of vast knowledge, good humor, and inspiration. The best way we know to honor our dear friend and mentor is to carry on his legacy of outstanding textbooks in introductory nutrition. *Wardlaw's Contemporary Nutrition: A Functional Approach* will continue to evolve and reflect current trends and breakthroughs in nutrition science, but Dr. Wardlaw's fingerprints will remain on every page.

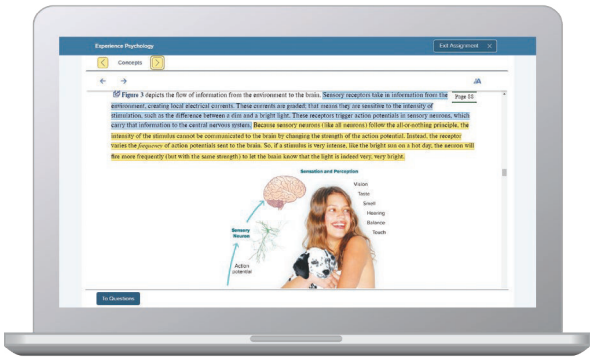
FOR INSTRUCTORS

You're in the driver's seat.

Want to build your own course? No problem. Prefer to use our turnkey, prebuilt course? Easy. Want to make changes throughout the semester? Sure. And you'll save time with Connect's auto-grading too.

65%

Less Time Grading



Laptop: McGraw-Hill; Woman/dog: George Doyle/Getty Images

They'll thank you for it.

Adaptive study resources like SmartBook® 2.0 help your students be better prepared in less time. You can transform your class time from dull definitions to dynamic debates. Find out more about the powerful personalized learning experience available in SmartBook 2.0 at **www.mheducation.com/highered/connect/smartbook.**

Make it simple, make it affordable.

Connect makes it easy with seamless integration using any of the major Learning Management Systems—Blackboard®, Canvas, and D2L, among others—to let you organize your course in one convenient location. Give your students access to digital materials at a discount with our inclusive access program. Ask your McGraw-Hill representative for more information.

Padlock: Jobalou/Getty Images

Solutions for your challenges.

A product isn't a solution. Real solutions are affordable, reliable, and come with training and ongoing support when you need it and how you want it. Our Customer Experience Group can also help you troubleshoot tech problems—although Connect's 99% uptime means you might not need to call them. See for yourself at **status.mheducation.com.**

Checkmark: Jobalou/Getty Images

SUPPORT AT every step

FOR STUDENTS

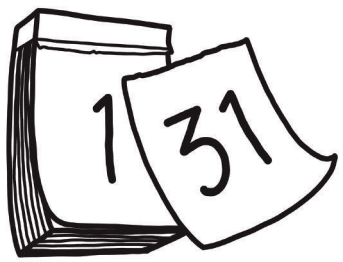
Effective, efficient studying.

Connect helps you be more productive with your study time and get better grades using tools like SmartBook 2.0, which highlights key concepts and creates a personalized study plan. Connect sets you up for success, so you walk into class with confidence and walk out with better grades.

Study anytime, anywhere.

Download the free ReadAnywhere app and access your online eBook or SmartBook 2.0 assignments when it's convenient, even if you're offline. And since the app automatically syncs with your eBook and SmartBook 2.0 assignments in Connect, all of your work is available every time you open it. Find out more at **www.mheducation.com/readanywhere.**

> ***"I really liked this app—it made it easy to study when you don't have your textbook in front of you."***
>
> - Jordan Cunningham, Eastern Washington University



Calendar: owattaphotos/Getty Images

No surprises.

The Connect Calendar and Reports tools keep you on track with the work you need to get done and your assignment scores. Life gets busy; Connect tools help you keep learning through it all.

Learning for everyone.

McGraw-Hill works directly with Accessibility Services Departments and faculty to meet the learning needs of all students. Please contact your Accessibility Services office and ask them to email accessibility@mheducation.com, or visit **www.mheducation.com/about/accessibility** for more information.

Top: Jenner Images/Getty Images, Left: Hero Images/Getty Images, Right: Hero Images/Getty Images

Connecting Teaching and Learning

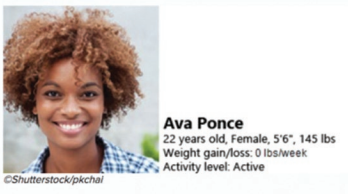
vicushka/123RF

McGraw Hill NutritionCalc Plus

NutritionCalc Plus is a **powerful dietary analysis tool** featuring more than 30,000 foods from the reliable and accurate ESHA Research nutrient database, which is comprised of data from the latest USDA Standard Reference database, manufacturer's data, restaurant data, and data from literature sources. NutritionCalc Plus allows users to track food and activities, and then analyze their choices with a robust selection of intuitive reports. The interface was updated to accommodate ADA requirements and modern mobile experience native to today's students.

Dietary Analysis Case Studies in Connect®

> The case studies provide a neutral way for my students to explore dietary analysis. My students are engaged by the case study assignments and find them easy to use. The fact that they are auto-graded gives me more time to focus on content development and instruction for my course.
>
> **–Hannah Thornton, Texas State University**



©Shutterstock/pkchai

One of the challenges instructors face with teaching nutrition classes is having time to grade individual dietary analysis projects. To help overcome this challenge, assign auto-graded dietary analysis case studies. These tools require students to use NutritionCalc Plus to analyze dietary data, generate reports, and answer questions to **apply their nutrition knowledge to real-world situations**. These assignments were developed and reviewed by faculty who use such assignments in their own teaching. They are designed to be relevant, current, and interesting!

McGraw Hill create®

McGraw-Hill Create® is a self-service website that allows you to create customized course materials using McGraw-Hill's comprehensive, cross-disciplinary content and digital products.

McGraw Hill tegrity®

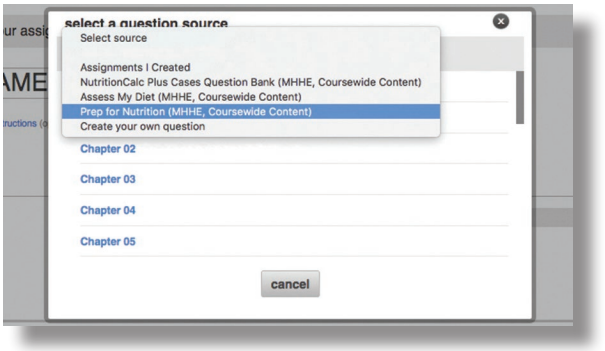
Tegrity in Connect is a tool that makes class time available 24/7 by automatically capturing every lecture. With a simple one-click start-and-stop process, you capture all computer screens and corresponding audio in a format that is easy to search, frame by frame. Students can replay any part of any class with easy-to-use, browser-based viewing on a PC, Mac, or other mobile device.

Educators know that the more students can see, hear, and experience class resources, the better they learn. Tegrity's unique search feature helps students efficiently find what they need, when they need it, across an entire semester of class recordings. Help turn your students' study time into learning moments immediately supported by your lecture.

Source: Jill Paisley

Assess My Diet

Auto-graded personalized dietary analysis. Students are using NutritionCalc Plus to analyze their own dietary patterns. But how can instructors integrate that information into a meaningful learning experience? With Assess My Diet, instructors can now assign auto-graded, personalized dietary analysis questions within Connect. These questions refresh their memory on the functions and food sources of each nutrient and prompt the students to evaluate their own eating behaviors. Students can evaluate their own nutrient intakes compared to current Dietary Reference Intakes and demonstrate their ability to perform calculations on their own data, such as percent of calories from saturated fat. They can compare the nutrient density of their own food selections to see which of their food choices provides the most fiber or iron. A benefit of the Assess My Diet question bank is that it offers assignable content that is personalized to the students' data, yet it is still auto-graded. It **saves time** and keeps all assignments in one place.



Prep for Nutrition

To help you **level-set your classroom**, we've created Prep for Nutrition. This question bank highlights a series of questions, including Basic Chemistry, Biology, Dietary Analysis, Mathematics, and Student Success, to give students a refresher on the skills needed to enter and be successful in their course! By having these foundational skills, you will feel more confident your students can begin class, ready to understand more complex concepts and topics. Prep for Nutrition is **course-wide for ALL nutrition titles** and can be found in the Question Bank dropdown within Connect.

Campus

McGraw-Hill Campus® is a groundbreaking service that puts world-class digital learning resources just a click away for all your faculty and students. All your faculty–whether or not they use a McGraw-Hill title–can instantly browse, search, and access the entire library of McGraw-Hill instructional resources and services, including eBooks, test banks, PowerPoint slides, animations, and learning objects, from any Learning Management System (LMS), at no additional cost to your institution. Users also have single-on access to McGraw-Hill digital platforms, including Connect, ALEKS®, Create, and Tegrity.

Connecting Students to Today's Nutrition

Why the Functional Approach?

Wardlaw's Contemporary Nutrition: A Functional Approach is organized somewhat differently than the traditional nutrition textbook (as seen in the contents of *Contemporary Nutrition* shown on the right) in that Part Three presents information on vitamins, minerals, and water using "a functional approach." Instead of describing these nutrients in their traditional categories (e.g., water-soluble vitamins), we discuss them in groups based on their roles in fluid and electrolyte balance, body defenses, bone health, energy metabolism, blood health, and brain health. This format enables students to understand how these nutrients interact in food and in our bodies to support key functions that sustain our health.

Understanding Our Audience

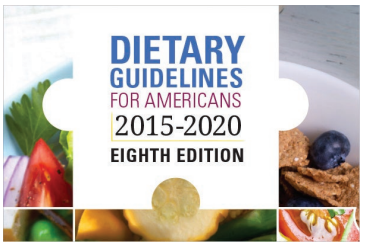
We have written *Wardlaw's Contemporary Nutrition: A Functional Approach* assuming that our students have a limited background in college-level biology, chemistry, or physiology. We have been careful to include the essential science foundation needed to adequately comprehend certain topics in nutrition, such as protein synthesis in Chapter 6. The science in this text has been presented in a simple, straightforward manner so that undergraduate students can master the material and apply it to their own lives. The Concept Maps and detailed, annotated figures bring complex topics into view for students from any major.

Wardlaw's Contemporary Nutrition: A Functional Approach

Wardlaw's Contemporary Nutrition

Featuring the Latest Guidelines and Research

Nutrition is a dynamic field. A vast quantity of research constantly reshapes our knowledge of nutritional science. The sixth edition has been carefully updated to reflect current scientific understanding, as well as the latest health and nutrition guidelines. For everyday dietary and activity planning, students will learn about the *Dietary Guidelines for Americans, MyPlate,* and *Physical Activity Guidelines for Americans*. In discussions about specific nutrition concerns, the most recent data and recommendations from the Academy of Nutrition and Dietetics, American Heart Association, American Diabetes Association, American Institute for Cancer Research, National Academy of Medicine, and American Psychological Association have been included in this edition.



Source: U.S. Department of Health and Human Services and U.S. Department of Agriculture. *2015–2020 Dietary Guidelines for Americans*. 8th Edition. December 2015.

"Newsworthy Nutrition," a feature in each chapter, highlights the use of the scientific method in recently published research studies that relate to the chapter topics. In addition, assignable questions in Connect take learning a step further by asking students to read primary literature and apply what they have learned.

Newsworthy Nutrition

Early introduction of peanut protein reduces peanut allergy

INTRODUCTION: Based on a hypothesis that early introduction of food proteins to infants increased risk for food allergies, pediatricians once advised parents to delay introduction of potential food allergens (e.g., 2 years for eggs and 3 years for peanuts, tree nuts, and fish). However, in the 1990s, evidence started to accumulate that delaying introduction of a variety of foods provided no benefit for preventing food allergies. For instance, Jewish children raised in the United Kingdom, where peanuts were not introduced until after 1 year of age, were 10 times more likely to develop peanut allergies than Jewish children raised in Israel, where peanut-based foods are introduced within the first year of life. **OBJECTIVE:** The Learning Early About Peanut Allergy (LEAP) trial aimed to see if early introduction of peanut protein could prevent peanut allergies among at-risk children. **METHODS:** The randomized, controlled trial included 640 infants between 4 and 11 months of age who were at risk for food allergies (based on existing allergies, severe eczema, or both). Participants were divided into two groups based on previous sensitization to peanut protein (i.e., skin testing showed if the infants' immune systems had already reacted to peanut protein from dietary, skin, or respiratory exposure). Next, the infants were randomized to treatment or control groups. The treatment group received at least 6 grams of peanut protein per week in the form of a peanut-based snack food or smooth peanut butter, while the control group was advised to avoid dietary exposure to peanuts. **RESULTS:** At 5 years of age, the children were tested for peanut allergy using an oral food challenge. Among the children who were not sensitized to peanuts at baseline, peanut consumption reduced the risk of developing peanut allergy by 86.1% compared to controls. Among the children who were initially sensitized to peanut protein, treatment with peanut protein reduced the risk of developing peanut allergy by 70%. **CONCLUSION:** The researchers concluded that early (< 11 months), sustained peanut consumption reduced peanut allergy among children at risk of food allergies.

Source: Du Toit G and others: Randomized trial of peanut consumption in infants at risk for peanut allergy, *New England Journal of Medicine* 372:803, 2015.

"Ask the RDN" appears in every chapter to answer frequently asked questions we hear from our students and colleagues. For many topics including plant-based eating, sustainability, and child nutrition, we have reached out to experts in their fields to answer questions. This feature will highlight the ability of the RDN to translate the latest scientific findings into easy-to-understand, practical, and applicable nutrition information.

ASK THE RDN **Plant-Based Eating**

Dear RDN: *I am hearing more and more about the health benefits of a plant-based eating pattern. Can you give me some tips on replacing meat and dairy with high-quality plant proteins?*

Regularly consuming foods high in plant proteins, such as legumes (including tofu and other soybean products), whole grains, nuts, and seeds can help prevent and reverse a slew of chronic conditions, including cancer, diabetes, and heart disease. Plant foods are packed with fiber and phytochemicals that support immunity, combat inflammation, and promote healthy bacteria in our gut. As an added bonus, plant proteins are far more affordable, sustainable, and lower in terms of environmental impact than animal proteins.

The good news is that you don't have to swear off meat forever to reap these benefits. Research suggests that following a flexitarian diet (increasing plant-based foods and reducing, but not eliminating, animal foods) yields similar health benefits like reduced risk of heart disease and diabetes. Eating less meat doesn't mean you're going to suffer from protein deficiency any time soon, either. It's important to note that protein is found in *all* foods; and it's nearly impossible not to get enough protein if you're eating enough calories.

In order to transition to a more plant-centric dietary pattern, start small. Overturning your entire eating pattern in a day can be a bit overwhelming initially. Instead of jumping to extremes, pick two small changes to implement each week. First, it may be swapping cow's milk with unsweetened almond or coconut milk. The great thing about nondairy beverages is that they're lower in calories and pack more calcium and vitamin D than dairy milk. Make your morning oatmeal with almond milk and stir in a tablespoon of peanut butter and chia seeds for a protein boost. Chia seeds are a hydrating powerhouse, made up of 20% protein and 25% fiber while absorbing up to 30 times their weight in water.

Did you know ¼ cup of pumpkin seeds has 7 grams of protein? Or that hemp seeds are the highest-protein seed with 3 grams of protein per tablespoon? Peanuts boast the most protein in the nut category with 7 grams per serving. For a tasty chocolate-banana shake, blend together 1 large frozen overripe banana, 1 tbsp peanut butter, 1 tbsp hemp seeds, 1 tbsp cocoa powder, a handful of spinach, and 1 cup unsweetened vanilla almond milk. Breakfast is served!

For lunches, try power bowls made with a base of wild rice or quinoa, which yield 6 and 8 grams of protein per serving, respectively. Top with ½ cup beans, chickpeas, or baked tempeh, a handful of arugula, avocado slices, a drizzle of tahini and lemon juice, and a sprinkle of hemp seeds for a calcium boost. If you're craving a sandwich, stuff a sprouted wheat wrap with ½ cup of black beans, a sprinkle of corn, salsa, avocado, crunchy romaine, and hot sauce.

Consider pasta night. Instead of refined white pasta, try one of the many bean or lentil-based noodles on the market. You can find spaghetti, fusilli, and penne made from black beans, lentils, or chickpeas that all boast 13 grams of protein or more per serving. Stick with 100% whole grain pasta, and you've still got 8 grams of protein and 25% of the Daily Value of fiber per serving. On top of pasta, instead of parmesan, sprinkle nutritional yeast, a cheesy-tasting inactive yeast that's packed with protein and vitamin B-12. Drizzle a tablespoon of tahini and hemp seeds on your green salad for another 6 grams of protein.

For stir-fry night, swap the chicken for high-protein edamame, which you can usually find in the freezer section of your grocery store. Soy is not only a complete plant protein, but it also has a high concentration of branched-chain amino acids, which are beneficial to athletic performance. Many stores sell marinated tofu (or try tempeh) that's delicious in stir-fry as well. For a tasty peanut sauce, whisk together ¼ cup natural peanut butter, ¼ cup almond milk, 4 tsp honey, and 4 tsp reduced sodium soy sauce.

When you're craving chili, swap the meat for a couple cans of kidney beans. Adding sautéed mushrooms to the mix will up the umami factor and add meatiness. Boost spices like oregano and chili powder for extra flavor. High-plant-protein dinner is served!

When it comes to baking, experiment with nut- and seed-based flours. Peruse your favorite food blogs for chocolate chip cookies or banana bread made with almond flour or coconut flour for a protein boost. These versions are lower in carbohydrates and super moist thanks to the healthy fat content.

There's no doubt about it—plant proteins are trending *for good.* Do your health and wallet a favor and hop on the bandwagon!

©Raul Velasco

Enjoy your plant proteins,

Alexis Joseph, MS, RD, LDN

The "Medicine Cabinet" feature presents information on common medications used to treat diseases that have a nutrition connection. These features highlight the ways medications can affect nutritional status, as well as ways food and nutrients can affect how medications work.

Medicine Cabinet

People who are prone to develop blood clots may take anticoagulants or "blood thinners." One commonly prescribed anticoagulant is Coumadin® (warfarin). This medication inhibits vitamin K–dependent coagulation factors. When taking Coumadin or similar drugs, it is important to keep dietary intake of vitamin K consistent from day to day.[4]

©Peter Dazeley/Photographer's Choice/Getty Images

Connecting with a Personal Focus

Valuing Our Food Supply

In this edition, we introduce a new "Farm to Fork" feature. Each chapter spotlights a food item and traces its path to our plates. Where does it grow? How do you select the most flavorful and nutritious foods? What are the best ways to store and prepare foods to maximize nutritional value?

Applying Nutrition on a Personal Level

Throughout the sixth edition, we reinforce the fact that each person responds differently to nutrients. To further convey the importance of applying nutrition to their personal lives, we include many examples of people and situations that resonate with college students. We also stress the importance of learning to intelligently sort through the seemingly endless range of nutrition messages to recognize reliable information and to sensibly apply it to their own lives. Our goal is to provide students the tools they need to eat healthfully and make informed nutrition decisions after they complete the class. Many of these features can be assigned and graded through Connect to help students learn and apply the information and engage with the text.

CASE STUDY College Student Eating Habits

Andy is like many other college students. He grew up on a quick bowl of cereal and milk for breakfast and a hamburger, French fries, and cola for lunch, either in the school cafeteria or at a local fast-food restaurant. At dinner, he generally avoided eating any of his salad or vegetables, and by 9:00 P.M. he was deep into bags of chips and cookies. Andy has taken most of these habits to college. He prefers coffee for breakfast and possibly a chocolate bar. Lunch is still mainly a hamburger, French fries, and cola, but pizza and tacos now alternate more frequently than when he was in high school. One thing Andy really likes about the restaurants surrounding campus is that, for a few cents more, he can make his hamburger a double or get extra cheese and pepperoni on his pizza. This helps him stretch his food dollar; searching out large-portion value meals for lunch and dinner has become part of a typical day. Now that he is in college, some of Andy's calories come from alcohol. He will have a beer with dinner a couple nights a week and will binge on a six-pack or more while tailgating before Saturday football games.

Provide Andy some advice about his eating pattern. Start with his positive habits and then provide some constructive criticism, based on what you now know.

Answer the following questions, and as you make suggestions for Andy, think about your favorite food choices, why they are your favorites, and whether these are positive choices.

▲ Now that he is a college student, Andy could use some advice on developing a healthy, adult eating pattern. Dinodia Photos/Alamy

Challenging Students to Think Critically

The pages of *Wardlaw's Contemporary Nutrition: A Functional Approach* contain numerous opportunities for students to learn more about themselves and their diet and to use their new knowledge of nutrition to improve their health. These pedagogical elements include "Ask the RDN," "Case Studies," "Nutrition and Your Health," "What Would You Choose?," and "Newsworthy Nutrition." Many of the thought-provoking topics highlighted in these features are expanded upon in the online resources found in Connect.

FARM to FORK Onions and Garlic

Pixtal/age fotostock

Onions and garlic, along with shallots, scallions, chives, and leeks, are part of the allium family. The alliums have long been associated with health and medicinal properties. The hot, pungent flavor of alliums comes from thiosulfinates, compounds that contain the mineral sulfur. Some of these compounds have been shown to have antiviral and antibacterial properties.

Grow

- The most common garlic grown in America, the California silverskin, is very productive. Plant one clove and a new head grows with 16 cloves.
- Several varieties of onions are grown, including white, yellow, red, pearl, and the sweet onions, such as Vidalia.
- Farmers have cultivated larger and sweeter varieties of onions that are popular but have much lower health benefits than wild varieties.
- Green onions, or scallions, are one of the most nutritious alliums and are easy to grow even in small gardens.

Shop

- Buy garlic bulbs that are plump and tightly encased in their papery outer wrapping. If the outer skin is loose or frayed, the bulbs may be dried or moldy.
- Purchase onions with their papery skin intact; this outer skin preserves the juiciness of the onion and protects it from mold and fungal infections.

What Would You Choose?

You are gearing up to run your first half-marathon in a few weeks. From your long training runs, you know that physical and mental fatigue may set in a few miles before the finish. You've practiced healthy dietary patterns throughout training but have trouble eating during your runs. You want to try one of those sports nutrition products to help get you through the last few miles. What would you choose to take along during the race to help you make it to the finish line?

a. Clif Shot® Turbo energy gel with 100 milligrams caffeine, 22 grams of carbohydrate, and electrolytes
b. PowerBar ProteinPlus® energy bar with 23 grams of protein
c. Powerade® sports drink with electrolytes, vitamins, and 14 grams of carbohydrate
d. Essential Amino Energy™ drink with branched-chain amino acids

13.7 Nutrition and Your Health

Brain Health: Food for Thought

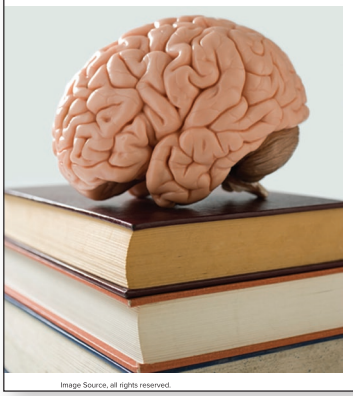


Image Source, all rights reserved.

dry weight. Omega-3 and omega-6 fatty acids (including the two essential fatty acids, alpha-linolenic acid and linoleic acid) are used to form phospholipids, which are key players in the formation and maintenance of healthy cell membranes in the brain and nerve cells. Deficiencies of omega-3 or omega-6 fatty acids in the prenatal period or during infancy are detrimental to optimal brain health. Choline (see Section 12.11) is vital for the synthesis of two phospholipids, phosphatidylcholine and sphingomyelin, that are highly concentrated in nervous tissue.

Iodine is a vital nutrient during brain growth and development. As you read in Section 12.8, iodine is involved in the synthesis of thyroid hormones, which regulate growth, development, and metabolism. In utero and shortly after birth, iodine participates in the myelination of nerves. Iodine deficiency during early development can result in intellectual disabilities.

Iron is another trace mineral that is vital during brain formation. Iron participates in the pathways that yield energy to fuel the brain, the myelination of nerve tissue, and the formation of neurotransmitters. A deficiency of iron during brain growth and development may result in impaired learning ability and behavioral problems.

Fueling the Brain. The preferred source of fuel for the brain and nervous tissue is glucose, but the brain does not have any way to store appreciable amounts of this carbohydrate. Most of the time, the brain relies on the glucose that is circulating in the blood from your last meal. During times of fasting (e.g., overnight, very-low-carbohydrate diets), glucose can be derived from the breakdown of liver glycogen or the conversion of amino acids to glucose in the liver and kidneys. When the body is in a state of starvation, the brain is able to utilize ketone bodies (by-products of fatty-acid metabolism) as a source of fuel. How-

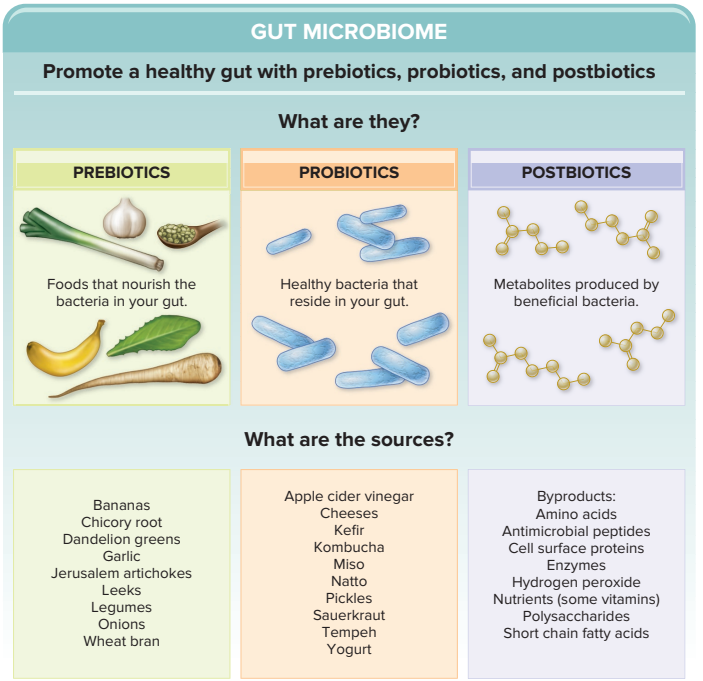
Connecting to Engaging Visuals

Attractive, Accurate Artwork

Illustrations, photographs, infographics, and tables in the text were created to help students master complex scientific concepts.

- Many illustrations were redesigned or replaced to inspire student inquiry and comprehension and to promote interest and retention of information. Several new infographics have been created to present materials in a more attractive, contemporary style.
- In many figures, color-coding and directional arrows make it easier to follow events and reinforce interrelationships. Process descriptions appear in the body of the figures. This pairing of the action and an explanation walks students step-by-step through the process and increases teaching effectiveness.
- Throughout the chapters, every photo and caption has been chosen with the intention to spark critical thinking.

The final result is a striking visual program that holds readers' attention and supports the goals of clarity, ease of comprehension, and critical thinking. The attractive layout and design of this edition are clean, bright, and inviting. This creative presentation of the material is geared toward engaging today's visually oriented students.



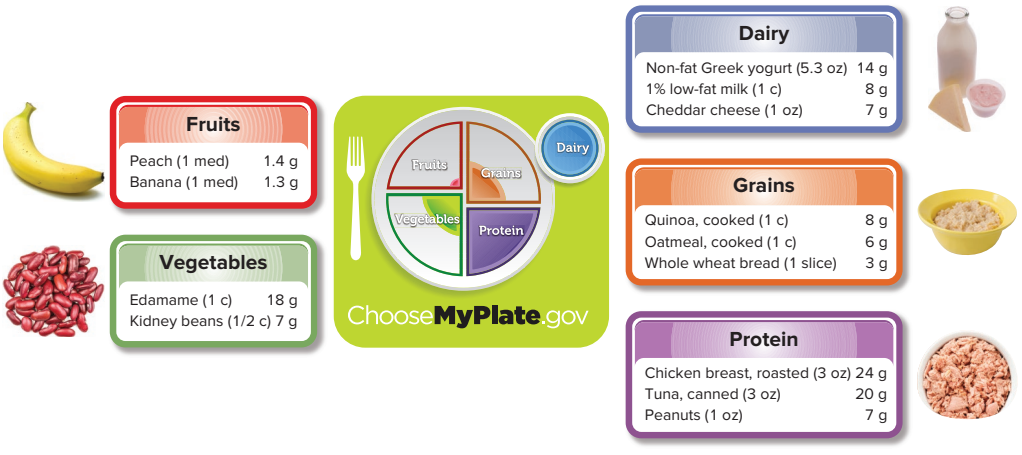


FIGURE 6-6 ▶ Food sources of protein. Overall, the dairy group provides much protein (8 to 10 grams per serving), as does the protein group (7 grams per serving). The fruits group provides little or no protein (less than 1 gram per serving). Food choices from the vegetables group and grains group provide moderate amounts of protein (2 to 3 grams per serving). (MyPlate): Source: U.S. Department of Agriculture; (banana): Alamy Stock Photo; (kidney beans): zerbor/123RF; (dairy): Getty Images; (oatmeal): McGraw-Hill Education; (tuna): Getty Images

Connecting with the Latest Updates

Global Changes

- All images of the Nutrition Facts Label have been updated to the new format approved by the U.S. Food and Drug Administration.
- "Ask the RDN" (Registered Dietitian Nutritionist) appears in every chapter and addresses questions we frequently hear students asking about food and nutrition topics covered in the popular media. We use the "Ask the RDN" in Chapter 1 to set the stage, answering the important question "How can I find a qualified nutrition expert who will give me personalized nutrition advice?" Each feature is answered and signed by a Registered Dietitian Nutritionist! Some are from this book's authors' point of view, but in this edition we also included several features written by our colleagues who are experts in their fields. Throughout the text, we have emphasized RDNs as the experts on nutrition.
- The new "Farm to Fork" feature appears in every chapter and presents practical information on how to grow, shop for, store, and prepare various fruits and vegetables to obtain and preserve their flavor and nutrients.
- The "Newsworthy Nutrition" feature has been updated to include headings (Objectives, Methods, Results, Conclusions) within the research summary.
- The term *physician* or *doctor* has been replaced with *primary care provider,* and references to the Institute of Medicine have been updated to its new name, National Academy of Medicine.
- The Case Study Solutions have been removed from all chapters, so that the *Case Study* can be used as an assignable project. Instructors can provide the solutions at their discretion.
- *Further Readings* are now superscripted in the text.

Chapter-by-Chapter Revisions

Chapter 1: *Nutrition, Food Choices, and Health*

- In Section 1.1 the popularity of home-delivered meals is now discussed relative to the effect of time and convenience on food choices.
- Figures 1-2 and 1-3 are new and illustrate USDA data from 2015 for vegetable and dairy product consumption, respectively. Figure 1-3 also compares 2015 dairy product consumption with that for 1975.
- Figure 1-4 provides an update on the 10 leading causes of death in the United States in 2016 as reported in July 2018 by the Centers for Disease Control and Prevention.
- Tomatoes, an important source of phytochemicals, are discussed in our new "Farm to Fork."
- In Section 1.4 on math concepts, practical examples of metric system conversions have been added. Examples include the conversion of grams of sugar in Greek yogurt to teaspoons and milliliters of water to cups.
- Section 1.6, What Is the Current State of the North American Eating Patterns and Health?, has been updated to reflect recent changes in obesity trends. Figure 1-8, showing the percentage of adults who were obese in 2017 as well as other obesity statistics, has been updated. "Newsworthy Nutrition" has been updated to "No Decrease in Adult Obesity Rates from 2005 to 2014," summarizing research published in the *Journal of the American Medical Association* in 2016.
- Section 1.8, Eating Well as a Student, has been updated to be more inclusive of college students of all ages, including returning students. More information is provided on how to eat well on a student's budget. The Case Study: College Student Eating Habits has been revised to include alcohol in the dietary pattern.
- The Further Readings have been updated with eight new articles.

Chapter 2: *Designing a Healthy Eating Pattern*

- "What Would You Choose" has been expanded to include snacks as well as beverages and asks which snack combination provides the best amount of calories, nutrients, and energy for an afternoon snack.
- Table 2-2, Energy Density of Common Foods, has been shortened and updated with more commonly consumed foods.
- Figure 2-4 has been added to illustrate adherence by Americans to the MyPlate recommendations.
- "Newsworthy Nutrition" summarizes recent research about the impact of diet quality on health outcomes.
- The *Physical Activity Guidelines* for Americans section and Table 2-4 have been updated to reflect the new 2018 U.S. Department of Health and Human Sciences Guidelines.
- "Farm to Fork" in Chapter 2 highlights carrots and beets, two colorful vegetables that fit into the Dietary Guideline to eat a variety from all five vegetable subgroups—dark green, red and orange, beans and peas, starchy, and others.
- Several updates have been made to the Section 2.3, MyPlate—A Menu Planning Tool. A new subsection, Build a Healthy Eating Style, includes ideas and tips to help create a healthier eating style. Categories include (1) All Food and Beverage Choices Matter—Focus on Variety, Amount, and Nutrition, (2) Choose an Eating Style Low in Saturated Fat,

Sodium, and Added Sugars, (3) Make Small Changes to Create a Healthier Eating Style (introduces the new MyPlate feature, MyWin), and (4) Support Healthy Eating for Everyone.

- Table 2-5 has been updated to show the connection between MyPlate food group serving sizes and calorie levels to improve comprehension and translation for students.
- Figure 2-7 is an updated and more detailed illustration of what counts as a serving and the use of standard objects to estimate serving sizes.
- The graphics and caption for Figure 2-8 have been updated to illustrate that all dairy is not the same. This bar graph compares the difference in calories from various types of milks and the added calories from fat and sugar in various milks compared to fat-free milk.
- The What's Cooking? USDA Mixing Bowl, an interactive tool for consumers who are ready to make a change and need help with healthy meal planning, cooking, and grocery shopping, has been added to the list of Additional MyPlate Resources. In addition, references to SuperTracker have been removed.
- When discussing the foundations of a healthy eating pattern, the word "balance" has replaced "proportionality" to simplify the language and align with the *Dietary Guidelines*.
- A new table (2-8) has been added to emphasize differences in food quality and calories between two different meals, both of which fit the proportions suggested by MyPlate.
- The Chronic Disease Risk Reduction Intakes (CDRR) DRI category has been added to Section 2.6.
- A new "Ask the RDN" pertaining to nutrition and transgender individuals, authored by Zach Breeding, has been added to Section 2.7.
- Table 2-11 has been shortened to emphasize the most common key food label definitions.
- Section 2.8, Food Labels and Diet Planning, includes a new subsection on Labeling of Food Allergens.
- Several new section Concept Check questions have been incorporated into Chapter 2, and 11 new Further Readings have been included.

Chapter 3: *The Human Body: A Nutrition Perspective*

- A new "What Would You Choose" highlights the low-FODMAP diet for use in the treatment of irritable bowel syndrome.
- Sections 3.1 and 3.2 have been reorganized to separate the discussion of the structure and function of the cell from the simple introduction to the concept of metabolism.
- "Farm to Fork" describes the benefits of cranberries, which help to prevent infections of the gastrointestinal and urinary tracts.
- Section 3.6 has been reworked to provide a more detailed introduction to the endocrine system, which comes up repeatedly throughout the text.
- Figures 3-1, 3-2, 3-4, 3-6, 3-7, 3-8, 3-9, 3-13, 3-15, 3-17, and 3-21 have been updated to an infographic style to more clearly explain key features of the body systems.
- In Section 3.9, a recently described taste sensation—oleogustus—is defined.
- "Newsworthy Nutrition" has been updated to present recent research on fecal transplant as a treatment for antibiotic-associated diarrhea.
- The discussion of Nutrition and Genetics has been moved to Chapter 6, where it will appear alongside pertinent information on gene expression.
- To provide students with additional resources, Chapter 3 includes 14 new Further Readings.

Chapter 4: *Carbohydrates*

- Section 4.2 contains a new Table 4-1 detailing the classifications of fiber (type, components, physiological effects, and major food sources).
- New to Section 4.2, the relationship between gut microbiota and fiber intake is described. A new infographic (Fig. 4-7) detailing prebiotics, probiotics, and postbiotics is included along with their main sources.
- A new Smart Beverage Choices infographic (Fig. 4-8) was added to Section 4.3 to help students recognize healthier beverage choices throughout the day and while purchasing at smoothie stands and coffee shops.
- A new Food Sources of Carbohydrate infographic (Fig. 4-9) was added to simplify the key concepts and provide visually appealing food source information to better resonate with student learners.
- Figure 4-10, the Whole Grains Council stamps for use on grain products, has been updated from two to three stamps with details for each plus the minimum requirements for whole grains per serving.
- The new "Farm to Fork" focuses on an excellent source of dietary fiber—potatoes.
- Several new or updated tables have been included to improve student comprehension in Section 4.3: Table 4-2 was added to highlight the main differences between whole and refined grains; Table 4-3 has been updated with 13 additional whole and ancient grains; common lactose-containing food sources have been added in Table 4-4; Table 4-5 has been edited to simplify the key points related to alternative sweeteners.
- The "To Sugar or Not to Sugar" content describes the pros and cons of consuming refined sugar and artificial sweeteners.
- Approved by the FDA in 2019, allulose has been added under alternative sweetners.
- Also in Section 4.3, energy and sports drinks were added to emphasize these as growing sources of added sugar in the United States.

- Figure 4-10 has been updated to improve the visual appeal and highlight the main organs involved in carbohydrate digestion and absorption.
- The section on glycemic index has been shortened, glycemic load introduced, and an emphasis placed on the role of lifestyle management of glucose control has been added.
- Section 4.6 now contains a new infographic promoting the *Dietary Guidelines* recommendations specific to carbohydrate intake.
- Also featured in Section 4.6 is a new "Newsworthy Nutrition" about intakes of sugar-sweetened beverages in the United States
- The Nutrition and Your Health featuring diabetes includes updated information on insulin pumps and highlights the importance of adhering to healthy lifestyle behaviors for disease management.
- A new infographic, Truthful Bites, debunks the top 10 common myths related to carbohydrates and provides the evidence behind the facts.
- New Concept Check questions have been added throughout Chapter 4 as well as 12 new or updated Further Readings.

Chapter 5: *Lipids*

- Section 5.1 has been revised to improve students' understanding of the chemistry of lipids, which is often daunting for non-majors.
- The structures of lipids in Figures 5-1 and 5-4 and the Concept Map are now displayed as ball-and-stick models, which give students a sense of the three-dimensional shape of lipids and how that might affect their functions.
- Figure 5-6 and the section on food sources of lipids have been revised to present the food sources of lipids more visually and give the students practical tips for choosing healthy fats.
- The discussion of *trans* fats has been revised in response to the ban on *trans* fats that went into effect in 2018. *Trans* fats have been removed from Figure 5-7.
- Food sources of omega-3 fatty acids are now presented as Table 5-1.
- Figure 5-10 has been updated with an infographic style to more clearly present the complex topic of digestion and absorption of lipids.
- Table 5-2 now includes visual cues to help students learn and remember the origin and composition of the various lipoproteins.
- The text in Sections 5.5 and 5.6 has been reorganized for clarity.
- "Newsworthy Nutrition" introduces the Nordic diet alongside the well-known Mediterranean diet.
- The content of the Nutrition and Your Health section has been simplified to focus less on medical treatments and more on dietary strategies to lower risk for cardiovascular disease. In addition, a new Figure 5-16 summarizes risk factors for cardiovascular disease and a new Figure 5-17 translates the American Heart Association's Diet and Lifestyle Recommendations into practical terms: dinner!
- Chapter 5 has been updated with 19 new Further Readings.

Chapter 6: *Proteins*

- "What Would You Choose" has been updated to focus more on consuming at least 20 to 30 grams of protein at a given meal to optimize muscle protein growth.
- Section 6.2 has been updated with the section on Protein Organization appearing before Protein Synthesis.
- Section 6.3, Protein in Foods, includes new information on evaluating protein quality, summarizing the new method (Digestible Indispensable Amino Acid Score [DIAAS]) for assessing the quality of dietary proteins that is recommended by the Food and Agriculture Organization of the United Nations (FAO).
- Figure 6-6 and the section on food sources of proteins have been revised to present the food sources of proteins more visually.
- Figure 6-7 has been updated to include photo examples of plant food combinations.
- Practical tips on using legumes as a source of protein are listed in the "Farm to Fork" feature.
- Figure 6-10 has been expanded to display eight separate images to represent the eight common food allergens. Content on the effects of high protein intakes has been moved to this section.
- In Section 6.4, Figure 6-11 has been redesigned as an infographic for easier understanding of protein digestion and absorption.
- In Section 6.5, Figure 6-13, Protein Concept Map, has been updated to illustrate the regulatory functions of protein.
- Section 6.6 contains new content on meal protein requirements, including discussion of maintaining a more equal distribution of protein at each meal, as well as the increased daily protein intake of $>$ 1.0 g/kg for older adults. Section 6.6 also includes "Active Eating Advice" in the form of an answer to the "Ask the RDN" question.
- The discussion of Nutrition and Genetics now appears as Section 6.8.
- Section 6.9 includes a new "Ask the RDN" on Plant-Based Eating, providing tips on replacing meat and dairy with high-quality plant proteins.
- Seven new articles are included in the Further Readings.

Chapter 7: *Energy Balance and Weight Control*

- The CDC obesity prevalence and trends have been updated throughout the text and figures to reflect the

most current data. A new Figure 7-2 has been added and includes both youth and adult obesity prevalence.

- Section 7.1 now contains a section related to obesity posing a threat to national security, and Further Readings contains a reference for those with additional interest in this topic.
- The Figure 7-6 infographic was created to highlight the contributions of basal metabolic rate, voluntary activity, and the thermic effect of food to energy output.
- Section 7.3, Assessing Healthy Body Weight, has been updated with current images to show students the newest technologies related to body composition.
- Section 7.3 now includes information about personal body fat scales that include body composition measures that sync with mobile devices for easier tracking. There is also information on using NutritionCalc Plus in Connect to estimate energy needs.
- Table 7-1 has been updated with all WHO categories and subcategories of body mass indices.
- Evidence-based updates for Health Problems Associated with Excess Body Fat have been revised and simplified in Table 7-2.
- The Biggest Loser previously in "Ask the RDN" has been replaced by one on Detox Diets in Section 7.4.
- "Farm to Fork" features amazing stone fruits.
- Figure 7-20 has been updated and contains images of real food containers bearing the new Nutrition Facts label.
- Table 7-5 has been condensed to include most popular physical activities and estimated calorie costs associated with each activity.
- The Blue Zone Power 9 has been added to Section 7.8 to showcase the nine key characteristics of centenarians globally.
- The Mindful Eating section now includes Intuitive Eating and Figure 7-21, emphasizing new findings in this area and behavioral triggers for eating. Also in this section are recommendations for implementing behavioral nudges to promote positive lifestyles.
- A new infographic about understanding weight bias, its impact, and examples of People First Language is presented in Figure 7-24.
- Updates to weight-loss medications, recommendations, and contraindications have been made in Section 7.9.
- The AspireAssist weight-loss device and Cryolipolysis, patented under the name CoolSculpting™ have been described in Section 7.9.
- Figure 7-25 has been condensed to reflect details of the most current bariatric procedures in a more detailed infographic format.
- Table 7-8 has been created to provide key information about the growth of youth bariatric surgeries.
- The five top-ranked Best Overall Diet Plans are presented in Table 7-9 and include category ranking such as "Best Heart-Healthy Diet" and "Best Weight-Loss Diet."
- Further Readings have been updated with seven new and updated references.

Chapter 8: *Overview of Micronutrients and Phytochemicals*

- A new image and text have been added on reusable produce bags that are environmentally friendly and reusable.
- A fat-soluble vitamin summary table has been updated and International Units (IU) removed.
- Examples of zoochemicals and phytochemicals were added to provide further clarification of these compounds.
- "Farm to Fork" focuses on crucifers such as broccoli, Brussels sprouts, and green leafy vegetables—all are excellent sources of disease-fighting phytochemicals and vitamins.
- Figure 8-6 has been updated to show the increasing sales of dietary supplements over time.
- A new "Ask the RDN" by contributor Karen Collins discusses dietary supplements and current evidence surrounding their use.
- Concept Check and other questions have been added throughout to stimulate critical thinking.
- New images throughout the chapter illustrate food sources of micronutrients and phytochemicals aligning with MyPlate.
- Nine new Further Readings have been added.

Chapter 9: *Fluid and Electrolyte Balance*

- Section 9.2, The Water Balancing Act, includes the new Table 9-1, Guidelines for Safe Use of Water Bottles, and a new section entitled "Is Sparkling or Seltzer Water Harmful for Teeth?"
- In Section 9.3, Figure 9-10 has been enhanced to include the movement of molecules during the change in ion concentrations in the fluid surrounding the cells.
- This chapter presents the latest Dietary Reference Intakes for sodium and potassium released by the National Academies of Sciences in March 2019, including the new category Chronic Disease Risk Reduction Intake (CDRR).
- New content on types of salt is included in the section Table Salt, Kosher Salt, Sea Salt—Which One Is Best?
- "Farm to Fork" discusses bananas and ties into the section on Getting Enough Potassium.
- Section 9.9, Minerals and Hypertension, highlights the new 2017 guidelines for the prevention, detection, evaluation, and management of high blood pressure in adults. Figure 9-17 has been updated with new effects of lifestyle changes on blood pressure.
- The Further Readings have been updated with six new articles.

Chapter 10: *Nutrients Involved in Body Defenses*

- To reflect changes in food labeling, references to International Units have been revised to point students to the more precise milligram or microgram units of measurement for vitamin A and vitamin E. Figure 10-13 no longer includes a column for IU.
- Figure 10-4 has been revised to more clearly illustrate how antioxidants protect cells from the damaging effects of free radicals.
- A new Figure 10-5 illustrates the multiple health effects of oxidative damage.
- In Section 10.3, the discussion of vitamin A deficiencies has been expanded.
- Garlic and onions, potential sources of selenium, are the focus of this chapter's "Farm to Fork."
- A new Figure 10-16 illustrates the antioxidant activity of common foods.
- "Newsworthy Nutrition" has been updated with a more recent study on antioxidants and risk for strokes.
- Postbiotics have been incorporated into the discussion of probiotics and prebiotics in Section 10.9.
- Figure 10-18 has been revised to match the new format of dietary supplement labels, mandated by the FDA to go into full effect by 2020.
- Section 10.10 on Nutrition and Cancer contains updated mortality statistics and a new Figure 10-19 to illustrate the burden of cancer in the United States. In addition, we have updated the section to include the latest American Institute for Cancer Research recommendations for cancer prevention.
- Chapter 10 has been updated with 30 new Further Readings.

Chapter 11: *Nutrients Involved in Bone Health*

- Figure 11-2 has been expanded to include more information on the steps involved in bone remodeling.
- The discussion of the regulation of blood calcium, including the action of calcitonin and parathyroid hormone (PTH), has been expanded and is now illustrated in Figure 11-4.
- Figures 11-5 and 11-6 are new illustrations of the many factors that enhance and inhibit calcium absorption, respectively.
- An update has been made to the summary of the 2018 Vitamin D, Calcium, or Combined Supplementation for the Primary Prevention of Fractures in Community-Dwelling Adults Task Force report.
- Mushrooms, a potential and unique source of vitamin D, are discussed in "Farm to Fork."
- Section 11.10 includes new information on the increased risk of osteoporosis in cancer patients.
- Table 11-3, Calcium Supplement Comparisons, has been reformatted to better highlight calcium content, forms, cost, and bioavailability as well as meal timing.
- Table 11-6, How Non-Dairy Milk Beverages Compare to Cow's Milk, now includes information on oat milk.
- There are eight new Further Readings.

Chapter 12: *Micronutrient Function in Energy Metabolism*

- Chapter 12 has been enhanced with 13 new color photographs.
- "Farm to Fork" discusses practical tips on how to grow, shop for, store, and prepare corn on the cob.
- Section 12.7 has been expanded with more information about biotin deficiency, including the impact of consuming raw eggs.
- The "What the Dietitian Chose" feature has been updated with new information on energy shots.
- Six new articles are included in Further Readings.

Chapter 13: *Nutrients That Support Blood and Brain Health*

- Figure 13-1 has been revised to emphasize the roles of micronutrients in blood cell formation.
- Figure 13-3 has been updated to better illustrate the importance of iron as part of hemoglobin.
- In Section 13.2, the discussion of vitamin K deficiency has been expanded.
- "Farm to Fork" informs students about selecting and preparing pomegranates.
- In Section 13.4, we have provided additional information about meeting vitamin B-12 needs on a plant-based diet. In addition, Figure 13-9 has been revised to an infographic format to more clearly explain the complex processes of vitamin B-12 digestion and absorption.
- In Section 13.7, we have updated the discussions of nutritional factors that influence migraines and depression.
- "Newsworthy Nutrition" now highlights a study on the impact of a Mediterranean diet on the emergence and progression of Alzheimer's disease.
- Seventeen new Further Readings have been added to reinforce the new concepts in this chapter.

Chapter 14: *Nutrition: Fitness and Sports*

- Physical activity recommendations throughout the chapter have been updated to align with the revised Physical Activity Guidelines for Americans published by the U.S. Department of Health and Human Services in 2018.
- Calculations for determining maximum and target heart rates have been put into a calculation box for students.
- Figure 14-1 has been updated to summarize the current mental and physical benefits of physical activity.

- The Rating of Perceived Exertion (RPE) scale in Figure 14-3 has been updated to reflect the common Borg Scale of Perceived Exertion.
- The Section title in 14.3 has been updated to Energy Sources for Active Muscles to reflect the updated guidelines and emphasize the fact that all activity requires energy.
- Figure 14-7 has been updated to provide a more streamlined and simplified view of ATP formation from macronutrients.
- A new Table 14-3 has been added in Section 14.4 and provides current recommendations for active adults and athletes related to dietary intake, body composition, hydration, and supplementation, adapted and summarized from the American College of Sports Medicine Position Statement.
- "Farm to Fork" features citrus fruits, often consumed by athletes before, during, and after competition.
- An emphasis on plant-based protein sources has been included and emphasized throughout the chapter.
- A new infographic in Section 14.4 highlights plant-based sources of protein. The role of vitamin D in athletics has also been added.
- The important issue of alcohol and binge drinking related to performance and athletics has been added under the fluid subsection in Section 14.4.
- The caffeine, calorie, and sugar contents of popular energy drinks have been updated and expanded in Table 14-5.
- Based upon the evidence, the title for Section 14.5 has been changed to Recommendations for Endurance, Strength, and Power Athletes.
- Table 14-9 has been updated with current data on energy bars, gels, and chews on the market.
- Table 14-10, which presents sample recovery meals, has been revised to a plant-based meal option for sports nutrition.
- The list of commonly used sports supplements and illegal substances have been expanded and updated in Tables 14-11 and 14-12.
- The list of recommended sports nutrition websites in Section 14.5 has been updated along with the Further Readings.

Chapter 15: *Eating Disorders*

- In Section 15.6, the discussions of relative energy deficiency in sport (formerly called *female athlete triad*) and eating disorders and diabetes have been updated with new research and terminology.
- A new "Ask the RDN" by Alexis Joseph explains the connections among energy availability, regular menstrual function, and bone health.
- "Farm to Fork" feature shows how an apple a day keeps the doctor away.
- Twenty new articles have been incorporated into the listing of Further Readings.

Chapter 16: *Global Nutrition*

- The chapter title has been changed to Global Nutrition to reflect a broader world view of malnutrition and nutrition-related topics.
- Statistics on both domestic and global poverty and hunger from the Food and Agriculture Organization of the United Nations (FAO) and the U.S. Census Bureau have been updated with the most recent data.
- Four new figures (Fig. 16-1, 16-2, 16-3, and 16-4) highlight the four dimensions of food security, global rates of undernourishment, and malnutrition and health, and the FAO integrated food security classifications, respectively.
- A new figure (Fig. 16-6) from FAO highlighting the link between food insecurity and multiple forms of malnutrition has been added to Section 16.1.
- Updates of the characteristics of users and impact of the federally subsidized nutrition programs, including SNAP, WIC, and Senior Nutrition Services that supply food for people in the U.S., has been expanded and updated in Section 16.2.
- Figure 16-7 has been created to highlight the trends in USDA expenditures for food and nutrition assistance.
- A new figure from the WHO, located in Section 16.3 (Fig. 16-8), emphasizes the universal and equitable access to safe water.
- Figure 16-9 has been added to graphically display the HIV prevalence for adults by World Health Organization (WHO) region.
- "Farm to Fork" highlights pineapples, often seen as a global staple providing key nutrients and an economic advantage for developing countries.
- Figure 16-11 is a new infographic, adapted from the FAO, describing the many facets of sustainable intensification in agriculture.
- The USDA's bioengineered labels are on display in Figure 16-13.
- A new "Ask the RDN" feature from contributor Leah McGrath focuses on organic and GMO crops.
- Undernutrition throughout all life stages (pregnancy through older adults) has been updated to reflect current prevalence and associated health outcomes.
- The Further Readings section includes 13 new references.

Chapter 17: *Protecting Our Food Supply*

- The chapter title has been changed to Protecting Our Food Supply to better reflect the chapter content, including the safety, security, and sustainability of food.

- Figure 17-2 is a map from the CDC that graphically depicts the reported foodborne disease outbreaks across the U.S.
- Also in Section 17.2, new Figure 17-2 shows the step-by-step process by which reported outbreaks prompt an investigation and, once confirmed, are shared with the public.
- In Section 17.1 bulleted lists are now used to highlight the reasons microorganisms are able to grow rapidly in foods. The section on consumer and industry trends that increase the risk of foodborne illnesses has been expanded to include natural disasters and the supply chain.
- All foodborne illness prevalence data and food import data have been updated throughout the chapter.
- Table 17-1, which summarizes the agencies responsible for monitoring the food supply in the United States, has been streamlined to improve readability.
- Information on recent examples, onset, symptoms, and sources of foodborne illness outbreaks has been updated and moved to Tables 17-3, 17-4, and 17-5 on the bacterial, viral, and parasitic causes of foodborne illnesses.
- In Section 17.3, the subsection on parasites is now titled Protozoan and Helminth Parasites to better reflect the type of parasites discussed.
- Photos have been added to Table 17-6, Types of Food Additives—Sources and Related Health Concerns, to illustrate the types of foods containing specific additives.
- Sources with references and/or weblinks have been added to all tables for quick reference.
- The discussion of the worldwide differences in the approach countries take to the approval of food additives has been expanded in Section 17.4, Food Additives.
- The generally recognized as safe (GRAS) determinations and notifications to strengthen oversight of food ingredients (Section 17-4) has been updated.
- Images have been added to Table 17-7 to provide visual examples of food sources that can cause foodborne illness.
- Popular energy drinks have been added to Table 17-8, Caffeine Content of Common Sources.
- Section 17.6 on Personal Action has been shortened to simplify the message about what students can do to reduce pesticide exposure.
- Melons are the topic of "Farm to Fork," including the potential for cantaloupes to harbor bacteria because of their "netted" surface.
- Agroterrorism and food biotechnology are new topics covered in Section 17.6.
- "Newsworthy Nutrition" summarizes new research about foodborne illnesses associated with organic foods.
- The topic of sustainability has been greatly expanded, including the potential results of sustainable agriculture, sustainable farming practices, and strategies to reduce your food waste and eat more sustainably.
- The Chapter 17 "Ask the RDN," written by contributing author and dietitian Chris Vogliano, contains practical advice for reducing food waste.
- The EPA's Food Recovery Hierarchy has been inserted as Figure 17-3.
- Figure 17-4, Effects of temperature on microbes that cause foodborne illness (Danger Zone), has been moved to Section 17.3, Effects of Temperature: The Danger Zone.
- The length of time to keep leftovers in the refrigerator has been updated in Section 17.8, Preventing Foodborne Illness.
- New Concept Check questions have been added, along with 13 new resources in the Further Readings.

Chapter 18: *Nutrition During Pregnancy and Breastfeeding*

- A new "Newsworthy Nutrition" discusses the impact of maternal dietary patterns and the cognitive development of the offspring.
- In Section 18.1, the latest evidence-based guidelines on treatment of polycystic ovary syndrome are discussed.
- In Section 18.4, the discussion of macronutrient needs of pregnant women has been broken into separate subsections to improve readability. Also, a separate subsection on fluid needs during pregnancy has been added.
- In Section 18.7, we have included information about the Baby-Friendly Hospital Initiative and defined a new term: *human milk oligosaccharides*.
- "Farm to Fork" focuses on greens, a good source of folate to support embryonic development.
- In Section 18.5, the information about a healthy dietary pattern during pregnancy has been incorporated into a new Figure 18-8.
- Further Readings now includes 54 updated resources.

Chapter 19: *Nutrition from Infancy Through Adolescence*

- Figures 19-1 and 19-2 have been annotated to show students how to plot growth and BMI on growth charts.
- In Section 19.2, information about iron supplementation has been updated to reflect the recommendations of the American Academy of Pediatrics.
- Figure 19-3 has been updated to the new food labeling format.
- In Section 19.3, a new subsection has been added about baby-led introduction to solid foods and a new term has been defined: *responsive feeding*.
- Section 19.4 now includes the most recent recommendations from the Physical Activity Guidelines for Americans. A new "Ask the RDN" from child nutrition expert Sally Kuzemchak provides practical advice to help caregivers cope with picky eating. A new term, *neophobia,* has been

defined. The discussion about links between nutrition and autism spectrum disorder has been updated.

- "Farm to Fork" is about blueberries, a nutrient-dense snack choice for children.
- "Newsworthy Nutrition" describes recent research on the connections between dietary patterns and acne.
- Section 19.7 has been updated with new statistics about food allergies and intolerances.
- Fifty-four new resources have been added to the Further Readings.

Chapter 20: *Nutrition During Adulthood*

- All aging demographic and prevalence data have been updated in Section 16.1. In addition, the entire chapter has been revised to emphasize healthy aging and active living during this period.
- A new figure from the World Health Organization (WHO) (Fig. 20-2) on aging and health emphasizes key influences of aging and recommendations for healthy aging. A new box also highlights healthy aging.
- A new "Newsworthy Nutrition" highlights research assessing the impact of dietary patterns on telomeres, a biomarker of aging.
- Figure 20-4 has been updated to match the most recent version of the Nutrition Screening Initiative's Nutrition Checklist for Older Adults, which utilizes the DETERMINE mnemonic.
- "Farm to Fork" focuses on grapes, a convenient and widely available fruit.
- Table 20-2 has been revised to provide a more comprehensive array of strategies to cope with the physiological changes of aging as adapted by the NIH National Institute of Aging.
- A new Table 20-3 summarizes the key physical activity guidelines for adults and older adults.
- Table 20-5 has been updated with the latest research on popular herbal remedies used by American adults, and references to some current and relevant online resources pertaining to complementary and alternative medicine are provided in the corresponding box.
- A box feature introduces the rising popularity of home-delivered meal kits and the most popular services available.
- Another box feature displays the results of a new meta-analysis that found additional benefits of eating 10 a day versus five a day for fruits and vegetables.
- Section 20.5, Nutrition Implications of Alcohol Consumption, has been updated to include the Centers for Disease Control and Prevention's definitions of moderate and heavy drinking.
- Figure 20-8 has been updated to include three additional standard drink sizes with grams and percent of alcohol in each.
- A box has been added in Section 20.5 that includes a link to an alcohol calculator.
- New Concept Check questions and several new resources have been added to the Further Readings.

Contents

Part One: Nutrition: A Key to Health



Breakfast bowl: Alexis Joseph/McGraw-Hill Education; happy family in the kitchen: Makistock/Shutterstock; chia pudding: Alexis Joseph/McGraw-Hill Education

Part Two: Energy Nutrients and Energy Balance




Dietary fiber: Marilyn Barbone/Shutterstock; healthy fat sources: Julija Dmitrijeva/123RF; eggs: Pixtal/AGE Fotostock; fruit: Thaiview/Shutterstock

Part Three: Vitamins, Minerals, and Water






Micronutrients/phytochemicals: Alexis Joseph/McGraw-Hill Education; lemon water: Sarah Rusnak; fruit salad: Lew Robertson/Brand Xpictures/Getty Images; cheese: John Foxx/Imagestate Media; oatmeal with fruit: Alexis Joseph/McGraw-Hill Education; beef and vegetables: Alexis Joseph/McGraw-Hill Education

Part Four: Nutrition: Beyond the Nutrients




swimmer: Erik Isakson/Blend Images LLC; woman: BananaStock/PunchStock; family: Zurijeta/Shutterstock; washing vegetables: KatarzynaBialasiewicz/Getty Images

Part Five: Nutrition: A Focus on Life Stages



Couple: Stockbyte/Getty Images; boy: Westend61/Getty Images; woman: Mary-Jon Ludy/McGraw-Hill Education

This page intentionally left blank

Student Learning Outcomes

Chapter 1 is designed to allow you to:

1.1 Describe how our food choices are affected by the flavor, texture, and appearance of food; routines and habits; early influences; advertising; nutrition and health concerns; dining out; convenience; cost; and hunger and appetite.

1.2 Identify diet and lifestyle factors that contribute to the 10 leading causes of death in North America.

1.3 Define the terms *nutrition, carbohydrate, protein, lipid (fat), alcohol, vitamin, mineral, water, phytochemical, kilocalorie (kcal),* and *fiber.*

1.4 Determine the total calories (kcal) of a food or diet using the weight and calorie content of the energy-yielding nutrients, convert English to metric units, and calculate percentages, such as percent of calories from fat in a diet.

1.5 Understand the scientific method as it is used in forming and testing hypotheses in the field of nutrition, including the determination of nutrient needs.

1.6 List the major characteristics of the North American diet, the food habits that often need improvement, and the current status and targets of the "Nutrition and Weight Status" objectives of the *Healthy People 2020* report.

1.7 Describe a basic plan for health promotion and disease prevention and what to expect from good nutrition and a healthy lifestyle.

1.8 Identify food and nutrition issues relevant to college students.

Alexis Joseph/McGraw-Hill Education

Chapter 1

Nutrition, Food Choices, and Health

What Would You Choose?

We begin each chapter with this activity to get you thinking. You are asked to make a choice using the chapter concepts. At the end of each chapter, we provide the logic behind what a dietitian would recommend.

You were awake last night until 2:30 A.M. finishing a class project. Unfortunately, your Psychology 101 class meets at 9:00 this morning. When your alarm goes off at 7:30 A.M., you decide to sleep those extra 20 minutes it would take to sit down and enjoy breakfast at the dining hall. What's your healthiest yet time-saving breakfast option?

a Skip breakfast but plan to consume a few extra calories at lunch and dinner.

b Consume a low-fat granola bar and iced coffee from the vending machines in your dorm.

c Eat a quick bowl of Wheaties™ with a banana and low-fat milk along with a yogurt, all from your dorm room "pantry."

d Pick up a ham, egg, and cheese bagel to eat during class.

Think about your choice as you read this chapter, then see "What the Dietitian Chose" at the end of the chapter.

Research has clearly shown that a lifestyle that includes a diet rich in fruits, vegetables, whole grains, and lean meat or plant protein, coupled with regular exercise, can enhance our current quality of life and keep us healthy for many years to come. Unfortunately, this healthy lifestyle is not always easy to follow. When it comes to "nutrition," it is clear that some of our eating patterns are out of balance with our metabolism, physiology, and physical activity level.

We begin this chapter with some questions. What influences your daily food choices? How important are factors such as taste, appearance, convenience, or cost? Is nutrition one of the factors you consider? Are your food choices influencing your quality of life and long-term health? By maintaining a healthy eating pattern, we can bring the goal of a long, healthy life within reach. This is the primary theme of this chapter and throughout this book.

The ultimate goal of this book is to help you find the best path to good nutrition. The information presented is based on emerging science that is translated into everyday actions that improve health. After completion of your nutrition course, you should understand the science behind the food choices you make and recommend to others. We call this achievement of making food choices that are healthy for you "nutrition literacy."

1.1 Why Do You Choose the Food You Eat?

In your lifetime, you will eat about 70,000 meals and 60 tons of food. Many factors—some internal, some external—influence our food choices. This chapter begins with a discussion of these factors and ends with a conversation specifically about eating well as a college student. In between, we examine the powerful effect of eating patterns in determining overall health and take a close look at the general classes of nutrients—as well as the calories—supplied by the food we eat. We also discuss the major characteristics of North American eating patterns, the food habits that often need improvement, and the current status of the "Nutrition and Weight Status" objectives of *Healthy People 2020*. A review of the scientific process behind nutrition recommendations is also included, along with an introduction to our "Farm to Fork," "Newsworthy Nutrition," and "Ask the RDN" features that appear in each chapter.

Understanding what drives us to eat and affects our food choices will help you understand the complexity of factors that influence eating, especially the effects of our routines and food advertising (Fig. 1-1). You can then appreciate why foods may have different meanings to different people and thus why others' food habits and preferences may differ from yours.

WHAT INFLUENCES YOUR FOOD CHOICES?

Food means much more to us than nourishment—it reflects much of what we think about ourselves. The Bureau of Labor Statistics estimated that in 2017, Americans spent 72 minutes a day eating and drinking. If we live to be 80 years old, that will add up to 4 years of eating and drinking. Overall, our daily food choices stem from a complicated mix of biological and social influences (see Fig. 1-1). The 2017 Food and Health Survey

FIGURE 1-1 ▶ Food choices are affected by many factors. Which have the greatest impact on your food choices?
Florian Franke/Purestock/SuperStock

found that, from a list of six factors, 84% said that taste influenced their food purchases, followed by price (66%), healthfulness (63%), convenience (49%), sustainability (38%), and brand name (35%). Let's examine some of the key reasons why we choose what we eat and then ask your instructor about the Rate Your Plate activities: Examine Your Eating Habits More Closely and Observe the Supermarket Explosion in Connect.

Flavor, texture, and appearance are the most important factors determining our food choices. Creating more flavorful foods that are both healthy and profitable is a major focus of the food industry. The challenge is to combine the "taste" of the foods we prefer with the best nutrition and health characteristics. The good news is that chefs and "food bloggers" are dedicating themselves to creating nutritious food that is also delicious.

Early influences related to various people, places, and events have a continuing impact on our food choices. Many food customs, including ethnic eating patterns, begin as we are introduced to foods during childhood. Parents can lay a strong foundation knowing that exposure to food choices during early childhood is important in influencing later health behaviors. Developing healthy patterns during childhood will help ensure healthy preferences and choices when we are teenagers and adults.

Eating habits, food availability, and convenience strongly influence choices. Recent Food Availability and Consumption data from the United States Department of Agriculture (USDA) show that Americans consume most of their calories from grain products (especially bread, pizza crust, macaroni, and spaghetti) and fats and oils (especially soybean oil). Potatoes and tomatoes are the most commonly consumed vegetables (Fig. 1-2), with French fries and pizza contributing to their popularity. Oranges and apples are the most commonly consumed fruits, but they are consumed mostly in juice form. Fluid milk and cheese, especially mozzarella cheese, comprise most of dairy consumption; fluid milk consumption has shown a big decline, while cheese consumption has doubled (Fig. 1-3).

Marketing and advertising are major tools for capturing the food interest of the consumer. Consumers have more food choices than ever and the food industry in the United States spends billions on advertising. Some of this advertising is helpful, as it promotes the importance of healthy food components such as calcium and fiber. However, the food industry also advertises highly sweetened cereals, cookies, snacks,

▲ Exposing children to growing, preparing, and eating healthy food options, such as this veggie pasta, will lay a strong foundation for healthful choices throughout life. ©Jeff Laubert

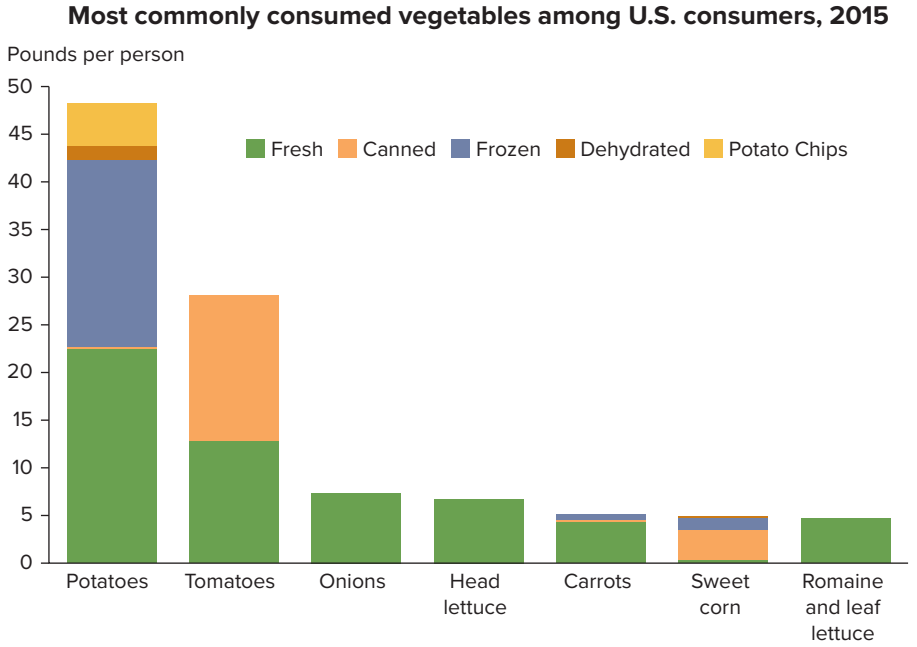
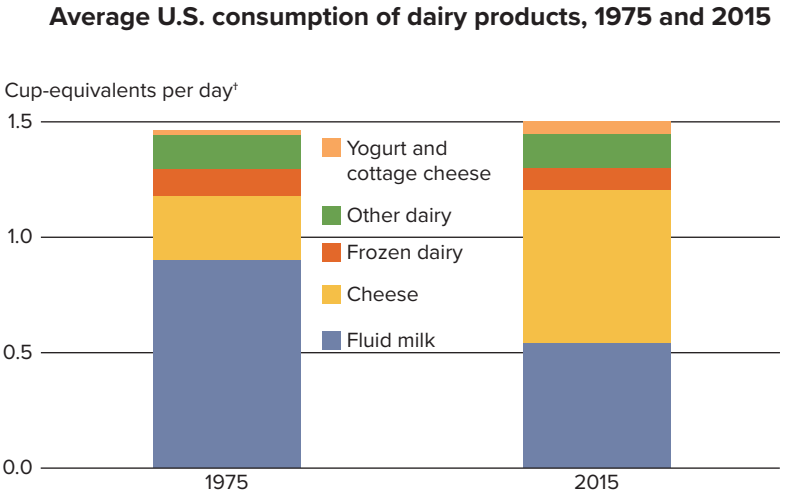


FIGURE 1-2 ◄ According to food availability data, the favorite vegetables of Americans are potatoes and tomatoes. In 2015, Americans consumed 48.3 pounds per person of potatoes, with half of the consumption as fresh potatoes; 28.3 pounds of tomatoes were consumed in 2015, with 55% as canned tomatoes. French fries and pizza contribute to the high consumption of these two vegetables.

Source: USDA, Economic Research Service, Loss-Adjusted Food Availability Data, 2015

FIGURE 1-3 ▶ According to food availability data from the USDA, Americans consumed a similar amount of dairy products (1.5 cup-equivalents of dairy products per person per day) in 1975 and in 2015. This is half the recommended amount for a 2000-calorie diet. Although the overall quantity is the same, the types of dairy products consumed have changed. Fluid milk consumption decreased from 0.9 to 0.5 cup per person per day, while cheese consumption has doubled.

Source: USDA, Economic Research Service, Loss Adjusted Food Availability Data.



†Based on a 2000-calorie-per-day diet. One cup-equivalent for dairy is: 1 cup milk or yogurt; 1½ ounces natural cheese or 2 ounces of processed cheese or ⅓ cup shredded cheese; 1 cup frozen yogurt or 1½ cups ice cream; 2 cups cottage cheese. Loss-adjusted food availability data are proxies for consumption. "Other dairy" includes evaporated milk, condensed milk, dry milk products, half and half, and eggnog.

Can healthy choices be legislated? Public health authorities have attempted to influence health behaviors by banning or taxing unhealthy foods or ingredients, whereas industries and many concerned citizens have opposed this expanding reach of the government. In 2013, a ban on the sale of sugary drinks in containers larger than 16 ounces in some establishments was approved by the New York City Board of Health. The beverage industry staunchly opposed the ban, and in June 2014 the New York Court of Appeals ruled that this ban overreached the health department's regulatory authority. Similar soda taxes in Berkeley have been well received, whereas efforts in Philadelphia were not well received. **Whose responsibility is it to determine which foods are good for you?** Dima Fadeev/Shutterstock

and soft drinks because they bring in the greatest profits. Studies have shown an association between TV advertising of foods and drinks and childhood obesity in the United States. A recent study found that preschoolers who were not hungry and who watched a show embedded with food advertisements consumed more calories from snacks than those who saw nonfood advertisements.[1] These findings suggest that exposure to food advertisements may encourage eating behaviors that promote obesity in the very young. Concern for the negative effects of advertising and marketing on the diets and health of children led the Council of Better Business Bureaus to establish the Children's Food and Beverage Advertising Initiative. Participants are 18 of the largest food and beverage companies that represent about 80% of child-directed television food advertising. The initiative is designed to shift the mix of foods advertised to children to encourage healthier dietary choices and healthy lifestyles.[2] Research also indicates that mass media influences the onset of eating disorders through its depiction of extremely thin models as stereotypes of attractive bodies. Eating disorders will be introduced in Eating Well in College (Section 1.8) and discussed at length in Chapter 15.

Restaurant dining plays a significant role in our food choices. Restaurant food is often calorie dense, in large portions, and of poorer nutritional quality compared to foods made at home. Fast-food and pizza restaurant menus typically emphasize meat, cheese, fried foods, and carbonated beverages. In response to recent consumer demands, restaurants have placed healthier options on their menus, and many are listing nutritional content there as well. Posting of the calorie content of restaurant items is now mandated by law. The law requires chain restaurants with 20 or more locations to post the calorie content of their offerings on menus or menu boards with other nutritional information available upon request. The intent of the law is to provide consumers with clear and consistent nutrition information so that they can make informed and healthful choices.

Time and convenience have become significant influences affecting food choices. Current lifestyles limit the time available for food preparation. A recent study in Seattle found that working adults who placed a higher priority on convenience than on home-cooked meals spent the least amount of time cooking. They spent more money eating away from home, especially at fast-food restaurants, suggesting that time is a key

ingredient in the development of healthier eating habits.[3] Restaurants, supermarkets, and meal delivery services have responded to our demanding work schedules and long hours away from home by supplying prepared meals, microwavable entrees, and quick-prep meals delivered to your door.

Cost and economics play a role in our food choices. The 2017 Food and Health Survey indicates that, after taste, cost is the number-two reason why people choose the food they do. While the average American now spends less on food than in the past, young adults and those with higher incomes spend the most on food. As income increases, so do meals eaten away from home. Keep in mind that as calorie intake increases, so does the food bill. Tips for eating well on a college student's budget are discussed in Section 1.8.

Sustainability is a relatively new factor that is affecting our food choices. With future generations in mind, many consumers are becoming more socially responsible to care for the environment. College students have become a big part of the movement to purchase local, seasonal, and sustainable food and to spread awareness that the way we produce and eat food can slow the rate of global warming, build strong communities, and improve our health.

Nutrition—or what we think of as "healthy foods"—also directs our food purchases. North Americans who tend to make health-related food choices are often well-educated, middle-class professionals who are generally health oriented, have active lifestyles, and focus on weight control. The 2017 Food and Health Survey found that about 58% of consumers sometimes use nutrition information to decide what to eat when away from home. The survey also showed that the components most likely considered to be healthful are vitamin D, fiber, whole grains, protein from plant sources, and omega-3 fatty acids. Nutrition and health information on food package labels has also been shown to affect food choices. A recent study found that people are less likely to buy sugary drinks if they see warning labels that include graphic pictures of health consequences such as obesity, diabetes, and tooth decay.[4]

Jacob is majoring in nutrition and is well aware of the importance of a healthy diet. He has recently been analyzing his diet and is confused. He notices that he eats a great deal of high-fat foods, such as peanut butter, cheese, chips, ice cream, and chocolate, and few fruits, vegetables, and whole grains. He also has become hooked on his daily cappuccino with lots of whipped cream. **What three factors may be influencing Jacob's food choices? What advice would you give him on how to have his diet match his needs?** ©Ingram Publishing

WHY ARE YOU SO HUNGRY?

Two drives, **hunger** and **appetite,** influence our desire to eat. These drives differ dramatically. Hunger is primarily our physical, biological drive to eat and is controlled by internal body mechanisms. For example, as foods are digested and absorbed, the stomach and small intestine send signals to the liver and brain telling us to reduce further food intake.

Appetite, our primarily psychological drive to eat, is affected by many of the external factors we discussed in the preceding section, such as environmental and psychological factors and social cues and customs (see Fig. 1-1). Appetite can be triggered simply by seeing a tempting dessert or smelling popcorn at the movie theater. Fulfilling either or both drives by eating sufficient food normally brings a state of **satiety,** a feeling of satisfaction that temporarily halts our desire to continue eating.

The *feeding center* and the *satiety center* are in the **hypothalamus,** a region of the brain that helps regulate satiety. They work in opposite ways, like a tug-of-war, to promote adequate availability of nutrients at all times. When we haven't eaten for a while, stimulation of the feeding center signals us to eat. As we eat, the nutrient content in the blood rises, and the satiety center is stimulated. This is why we no longer have a strong desire to seek food after a meal. Admittedly, this concept of a tug-of-war between the feeding and satiety centers is an oversimplification of a complex process. The various feeding and satiety messages from body cells to the brain do not single-handedly determine what we eat. We often eat because food comforts us.[5] Almost everyone has encountered a mouthwatering dessert and devoured it, even on a full stomach. It smells, tastes, and looks good. We might eat because it is the right time of day, we are celebrating, or we are seeking emotional comfort to overcome the blues. After a meal, memories of pleasant tastes and feelings reinforce appetite. If stress or depression sends you to the refrigerator, you are mostly seeking

hunger The primarily physiological (internal) drive to find and eat food.

appetite The primarily psychological (external) influences that encourage us to find and eat food, often in the absence of obvious hunger.

satiety A state in which there is no longer a desire to eat; a feeling of satisfaction.

hypothalamus a region of the forebrain that controls body temperature, thirst, and hunger.

comfort, not food calories. Appetite may not be a physical process, but it does influence food intake.

When food is abundant, appetite—not hunger—more frequently triggers eating. Satiety associated with consuming a meal may reside primarily in our psychological frame of mind. Also, because satiety regulation is not perfect, body weight can fluctuate. We become accustomed to a certain amount of food at a meal. Providing less than that amount leaves us wanting more. One way to use this observation for weight-loss purposes is to train your eye to expect less food by slowly decreasing serving sizes to more appropriate amounts. Your appetite then readjusts as you expect less food. We will discuss more about this mechanism, including the effect of meal size and composition on satiety, in Chapter 7 on energy balance and weight control. You should now understand that daily food consumption is a complicated mix of biological and social influences. Keep track of what triggers your eating for a few days. Is it primarily hunger or appetite?

☑ CONCEPT CHECK 1.1

1. What are the factors that influence our food choices?
2. Which two vegetables are the most commonly consumed in the U.S. and why?
3. How do hunger and appetite differ in the way they influence our desire to eat?
4. What factors influence satiety?

1.2 How Is Nutrition Connected to Good Health?

▲ Many foods are rich sources of nutrients. Cole Group/Getty Images

Fortunately, the foods we eat can support good health in many ways, depending on their components. You just learned, however, that lifestyle habits and other factors may have a bigger impact on our food choices than the food components themselves. Unfortunately, many North Americans suffer from diseases that could have been prevented if they had known more about the foods and, more importantly, had applied this knowledge to plan meals and design their eating pattern. We will now look at the effect these choices are having on our health both today and in the future.

WHAT IS NUTRITION?

Nutrition is the science that links foods to health. It includes the processes by which the human organism ingests, digests, absorbs, transports, uses, and excretes food substances.

NUTRIENTS COME FROM FOOD

What is the difference between food and **nutrients**? Food provides the energy (in the form of calories) as well as the compounds needed to build and maintain all body cells. Nutrients are the substances obtained from food that are vital for growth and maintenance of a healthy body throughout life. For a substance to be considered an **essential nutrient,** three characteristics are needed:

- At least one specific biological function of the nutrient must be identified in the body.
- Omission of the nutrient from the diet must lead to a decline in certain biological functions, such as production of blood cells.
- Replacing the omitted nutrient in the diet before permanent damage occurs will restore those normal biological functions.

nutrients Chemical substances in food that contribute to health, many of which are essential parts of a diet. Nutrients nourish us by providing calories to fulfill energy needs, materials for building body parts, and factors to regulate necessary chemical processes in the body.

essential nutrient In nutritional terms, a substance that, when left out of a diet, leads to signs of poor health. The body either cannot produce this nutrient or cannot produce enough of it to meet its needs. If added back to a diet before permanent damage occurs, the affected aspects of health are restored.

WHY STUDY NUTRITION?

We all may feel like nutrition experts because we all eat several times a day. Nutrition knowledge can be confusing, however, and seem like a moving target. Recommendations may seem to differ depending on their source, and there are so many choices when shopping for food or eating out. You just learned that nutrition is only one of many factors that influence our eating habits. Studying nutrition will help you erase any misconceptions you have about food and nutrition and make informed choices about the foods you eat and their relationship to health.

Nutrition is a lifestyle factor that is a key to developing and maintaining an optimal state of health. A poor diet and a sedentary lifestyle are known to be **risk factors** for life-threatening **chronic** diseases such as **cardiovascular (heart) disease, hypertension, diabetes,** and some forms of **cancer.** Together, these and related disorders account for two-thirds of all deaths in North America (Fig. 1-4).[6] Not meeting nutrient needs in younger years makes us more likely to suffer health consequences, such as bone fractures from the disease **osteoporosis,** in later years. At the same time, taking too much of a nutrient—such as a vitamin A supplement—can be harmful.

The combination of a poor eating pattern and too little physical activity may be the second leading cause of death in the United States. In fact, U.S. government statistics indicate that a poor eating pattern combined with a lack of sufficient physical activity contributes to hundreds of thousands of fatal cases of cardiovascular disease, cancer, and diabetes each year. In addition, **obesity,** which the American Medical Association declared as a disease in 2013, is considered the second leading cause of preventable death in North America (smoking is the first). Obesity and chronic diseases are often preventable, and the cost of prevention, usually when we are children and young adults, is small compared to the cost of treating these diseases when we are older.

The good news is that an increased interest in health, fitness, and nutrition in Americans has been associated with long-term decreasing trends for heart disease, cancer, and **stroke** (three of the leading causes of death). Mortality from heart disease, the leading cause of death, has been declining steadily since 1980. As you gain understanding about your nutritional habits and increase your knowledge about optimal nutrition, you will have the opportunity to dramatically reduce your risk for many common health problems. Recent research has shown that those following the healthiest eating pattern overall had a 65% lower risk of dying from cancer, or any other cause, than those who had followed the worst eating pattern. A healthy eating pattern was defined as one with a high proportion of vegetables, fruits, whole grains, proteins, and dairy.[7]

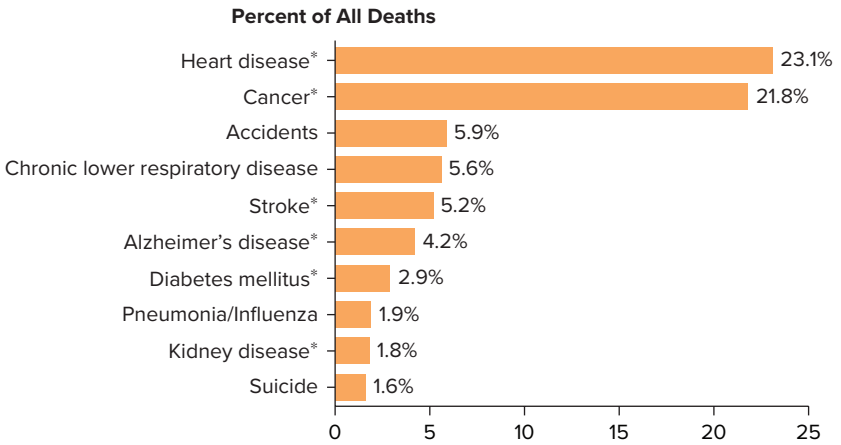


FIGURE 1-4 ▲ Ten leading causes of death in the United States.

Source: Centers for Disease Control and Prevention, *National Vital Statistics Report*, Deaths: Leading Causes for 2016. July 26, 2018.[6] Canadian statistics are quite similar.

* Causes of death in which diet plays a part.

risk factors A term used frequently when discussing the factors contributing to the development of a disease. A risk factor is an aspect of our lives, such as heredity, lifestyle choices (e.g., smoking), or nutritional habits.

chronic Long-standing, developing over time. When referring to disease, this term indicates that the disease process, once developed, is slow and lasting. A good example is cardiovascular disease.

cardiovascular disease A general term that refers to any disease of the heart and circulatory system. This disease is generally characterized by the deposition of fatty material in the blood vessels (hardening of the arteries), which in turn can lead to organ damage and death. Also termed coronary heart disease (CHD), as the vessels of the heart are the primary sites of the disease.

hypertension A condition in which blood pressure remains persistently elevated. Obesity, inactivity, alcohol intake, excess salt intake, and genetics may each contribute to the problem.

diabetes A group of diseases characterized by high blood **glucose.** Type 1 diabetes involves insufficient or no release of the hormone insulin by the pancreas and therefore requires daily insulin therapy. Type 2 diabetes results from either insufficient release of insulin or general inability of insulin to act on certain body cells, such as muscle cells. Persons with type 2 diabetes may or may not require insulin therapy.

glucose A six-carbon sugar that exists in a ring form; found as such in blood, and in table sugar bound to fructose; also known as *dextrose,* it is one of the simple sugars.

cancer A condition characterized by uncontrolled growth of abnormal cells.

osteoporosis The presence of a stress-induced fracture or a T-score of −2.5 or lower. The bones are porous and fragile due to low mineral density.

obesity Disorder involving excessive body fat that increases the risk of health problems.

stroke A decrease or loss in blood flow to the brain that results from a blood clot or other change in arteries in the brain. This in turn causes the death of brain tissue. Also called a *cerebrovascular accident.*

carbohydrate A compound containing carbon, hydrogen, and oxygen atoms. Most are known as *sugars, starches,* and *fibers.*

lipid A compound containing much carbon and hydrogen, little oxygen, and sometimes other atoms. Lipids do not dissolve in water and include fats, oils, and cholesterol.

protein Food and body compounds made of more than 100 amino acids; proteins contain carbon, hydrogen, oxygen, nitrogen, and sometimes other atoms in a specific configuration. Proteins contain the form of nitrogen most easily used by the human body.

vitamin An essential organic (carbon-containing) compound needed in small amounts in the diet to help regulate and support chemical reactions and processes in the body.

mineral Element used in the body to promote chemical reactions and to form body structures.

water The universal solvent; chemically, H_2O. The body is composed of about 60% water. Water (fluid) needs are about 9 (women) or 13 (men) cups per day; needs are greater if one exercises heavily.

kilocalorie (kcal) Heat energy needed to raise the temperature of 1000 grams (1 L) of water 1 degree Celsius.

macronutrient A nutrient needed in gram quantities in a diet.

micronutrient A nutrient needed in milligram or microgram quantities in a diet.

simple sugar Monosaccharide or disaccharide in the diet.

complex carbohydrate Carbohydrate composed of many monosaccharide molecules. Examples include glycogen, starch, and fiber.

starch A carbohydrate made of multiple units of glucose attached together in a form the body can digest; also known as *complex carbohydrate.*

cell The structural basis of plant and animal organization. In animals it is bounded by a cell membrane. Cells have the ability to take up compounds from and excrete compounds into their surroundings.

bond A linkage between two atoms formed by the sharing of electrons, or attractions.

fiber Substances in plant foods not digested in the human stomach or small intestine. These add bulk to feces. Fiber naturally found in foods is also called *dietary fiber.*

✓ CONCEPT CHECK 1.2

1. How do we define *nutrition?*
2. What are the three leading causes of death in which diet plays a part?

1.3 What Are the Classes and Sources of Nutrients?

To begin the study of nutrition, let's start with an overview of the six classes of nutrients. You are probably already familiar with the terms **carbohydrates, lipids** (fats and oils), **proteins, vitamins,** and **minerals.** These nutrients, plus **water,** make up the six classes of nutrients found in food.

Nutrients can be assigned to three functional categories: (1) those that primarily provide us with calories to meet energy needs (expressed in **kilocalories [kcal]**); (2) those important for growth, development, and maintenance; and (3) those that act to keep body functions running smoothly. Some overlap in function exists among these categories (Table 1-1). The energy-yielding nutrients (carbohydrates, lipids, and protein) along with water are needed in relatively large amounts, so they are called **macronutrients.** Vitamins and minerals are needed in such small amounts in the diet that they are called **micronutrients.**

CARBOHYDRATES

Chemically, carbohydrates can exist in foods as simple sugars and complex carbohydrates. **Simple sugars,** frequently referred to as *sugars,* are relatively small molecules. These sugars are found naturally in fruits, vegetables, and dairy products. Table sugar, known as sucrose, is a simple sugar that is added to many foods we eat. Glucose, also known as blood sugar or dextrose, is a simple sugar in your blood. **Complex carbohydrates** are formed when many simple sugars are joined together. Plants store carbohydrates in the form of **starch,** a complex carbohydrate made up of hundreds of glucose units. Breads, cereals, grains, and starchy vegetables are the main sources of complex carbohydrates.

During digestion, complex carbohydrates are broken down into single sugar molecules (such as glucose) and absorbed into the bloodstream via **cells** lining the small intestine. However, the **bonds** between the sugar molecules in certain complex carbohydrates, called **fiber,** cannot be broken down by human digestive processes. Fiber passes through the small intestine undigested to provide bulk for the stool (feces) formed in the large intestine (colon).

Aside from enjoying their taste, we need sugars and other carbohydrates in our diets primarily to help satisfy the calorie needs of our body cells. Carbohydrates

TABLE 1-1 ■ Major Functions of the Various Classes of Nutrients

Nutrient Classes That Provide Energy	Nutrient Classes That Promote Growth, Development, and Maintenance	Nutrient Classes That Regulate Body Processes
Most carbohydrates	Proteins	Proteins
Proteins	Lipids	Some lipids
Most lipids	Some vitamins	Some vitamins
	Some minerals	Some minerals
	Water	Water

provide a major source of calories for the body, on average 4 kcal per gram. Glucose, a simple sugar that the body can derive from most carbohydrates, is a major source of calories for most cells. When insufficient carbohydrate is consumed, the body is forced to make glucose from proteins—not a healthy alternative. Chapter 4 focuses on carbohydrates.

LIPIDS

Lipids (mostly fats and oils) in the foods we eat also provide energy. Lipids yield more calories per gram than do carbohydrates—on the average, 9 kcal per gram—because of differences in their chemical composition. They are also the main form for energy storage in the body.

In this book, the more familiar terms *fats* and *oils* will generally be used, rather than *lipids.* Lipids do not dissolve in water. Generally, fats are lipids that are solid at room temperature, and oils are lipids that are liquid at room temperature. We obtain fats and oils from animal and plant sources. Animal fats, such as butter or lard, are solid at room temperature. Plant oils, such as corn or olive oil, tend to be liquid at room temperature. To promote heart health, most people would benefit from using more plant oils in place of solid fats (see Chapter 5).

Certain fats are essential nutrients that must come from our diet. These key fats that the body cannot produce, called essential fatty acids, perform several important functions in the body: they help regulate blood pressure and play a role in the synthesis and repair of vital cell parts. However, we need only about 4 tablespoons of a common plant oil (such as olive or soybean oil) each day to supply these essential fatty acids. A serving of fatty fish, such as salmon or tuna, at least twice a week is another healthy source of fats. The unique fatty acids in these fish complement the healthy aspects of common plant oils. This will be explained in greater detail in Chapter 5, which focuses on lipids.

▲ Salmon is a fatty fish that is a healthy source of essential fatty acids.
Olga Nayashkova/Shutterstock

PROTEINS

Proteins are the main structural material in the body. For example, proteins constitute a major part of bone and muscle; they are also important components in blood, body cells, **enzymes,** and immune factors. Proteins can also provide calories for the body—on average, 4 kcal per gram. Typically, however, the body uses little protein for the purpose of meeting daily calorie needs. Proteins are formed when **amino acids** are bonded together. Some amino acids are essential nutrients.

enzyme A compound that speeds up the rate of a chemical reaction but is not altered by the reaction. Almost all enzymes are proteins (some are made of genetic material).

amino acid The building block for proteins containing a central carbon atom with nitrogen and other atoms attached.

Protein in our diet comes from animal and plant sources. The animal products meat, poultry, fish, dairy, and eggs are significant sources of protein in most eating patterns. Beans, grains, nuts, seeds, and some vegetables are good plant protein sources and are important to include in vegetarian eating patterns. If protein consumption is greater than what is needed for body functions, the excess is used for calorie needs and carbohydrate production but ultimately can be converted to and stored as fat. Chapter 6 focuses on proteins.

VITAMINS

The main function of vitamins is to enable many **chemical reactions** to occur in the body. Some of these reactions help release the energy trapped in carbohydrates, lipids, and proteins. Remember, however, that vitamins themselves contain no usable calories for the body.

chemical reaction An interaction between two chemicals that changes both chemicals.

The 13 vitamins are divided into two groups: four are **fat-soluble** because they dissolve in fat (vitamins A, D, E, and K); nine are **water-soluble** because they dissolve in water (the B vitamins and vitamin C). The two groups of vitamins have different sources, functions, and characteristics. Water-soluble vitamins are found mainly in

fat-soluble Soluble in fats, oils, or fat solvents.

water-soluble Capable of dissolving in water.

fruits and vegetables, whereas dairy products, nuts, seeds, oils, and breakfast cereals are good sources of fat-soluble vitamins. Cooking destroys water-soluble vitamins much more readily than it does fat-soluble vitamins. Water-soluble vitamins are also excreted from the body much more readily than are fat-soluble vitamins. Thus, the fat-soluble vitamins, especially vitamin A, have the ability to accumulate in excessive amounts in the body, which then can lead to toxicity. Vitamins are discussed in Chapters 8 through 13.

MINERALS

inorganic Any substance lacking carbon atoms bonded to hydrogen atoms in the chemical structure.

atom Smallest combining unit of an element, such as iron or calcium. Atoms consist of protons, neutrons, and electrons.

Minerals are structurally simple, **inorganic** substances that do not contain carbon **atoms.** Minerals such as sodium and potassium typically function independently in the body, whereas minerals such as calcium and phosphorus combine to function in tissue, such as bone. Because of their simple structure, minerals are not destroyed during cooking, but they can still be lost if they dissolve in the water used for cooking and that water is then discarded. Minerals are critical players in nervous system functioning, water balance, structural (e.g., skeletal) systems, and many other cellular processes but produce no calories as such for the body.

major mineral Vital to health, a mineral that is required in the diet in amounts greater than 100 milligrams per day.

trace mineral Vital to health, a mineral that is required in the diet in amounts less than 100 milligrams per day.

electrolyte A mineral that separates into positively or negatively charged ions in water. Electrolytes are able to transmit an electrical current.

The essential minerals required in the diet for good health are divided into two groups—**major minerals** and **trace minerals**—because dietary needs and concentrations in the body vary enormously. If daily needs are less than 100 milligrams, the mineral is classified as a trace mineral; otherwise, it is a major mineral. Minerals that function based on their electrical charge when dissolved in water are also called **electrolytes;** these include sodium, potassium, and chloride. Many major minerals are found naturally in dairy products and fruits, whereas many trace minerals are found in meats, poultry, fish, and nuts. Minerals are covered in Chapters 8 through 13.

WATER

Water makes up the sixth class of nutrients. Although sometimes overlooked as a nutrient, water (chemically, H_2O) has numerous vital functions in the body. It acts as a **solvent** and lubricant, as a vehicle for transporting nutrients and waste, and as a medium for temperature regulation and chemical processes. For these reasons, and because the human body is approximately 60% water, the average man should consume about 3 liters—about 13 cups—of water and/or other fluids every day. Women need closer to 2.2 liters or about 9 cups per day. Fluid needs vary widely, however, based on differences in body mass and environmental conditions.

solvent A liquid substance in which other substances dissolve.

Water is obviously available from all beverages and is also the major component in some foods, such as many fruits and vegetables (e.g., lettuce, grapes, and melons). The body even makes some water as a by-product of **metabolism.** Water is examined in detail in Chapter 9.

metabolism Chemical processes in the body by which energy is provided in useful forms and vital activities are sustained.

OTHER IMPORTANT COMPONENTS IN FOOD

phytochemical A chemical found in plants. Some phytochemicals may contribute to a reduced risk of cancer or cardiovascular disease in people who consume them regularly.

Another group of compounds called **phytochemicals** are found in foods from plant sources, especially within the fruit and vegetable groups. Although these phytochemicals are not considered essential nutrients in the diet, they provide significant health benefits. Considerable research is focused on the ability of various phytochemicals to reduce the risk for certain diseases. For example, evidence from animal and laboratory studies indicates that compounds in blueberries and strawberries prevent the growth of certain cancer cells. Research also suggests that the health benefits of phytochemicals are best obtained through the consumption of whole foods rather than dietary supplements. Foods with high phytochemical content are sometimes called "superfoods" because of the health benefits they are thought to confer. There is no legal definition of the term *superfood,* however, and there is concern that it is being overused in marketing certain foods. Table 1-2 lists some

TABLE 1-2 ■ Food Sources of Some Phytochemical Compounds Under Study

Food Sources	Phytochemical
Garlic, onions, leeks	Allyl sulfides/organosulfurs
Garlic, onions, licorice, legumes	Saponins
Orange, red, and yellow fruits and vegetables (egg yolks are a source as well)	Carotenoids (e.g., lycopene)
Oranges, lemons, grapefruit	Monoterpenes
Chili peppers	Capsaicin
Flaxseed, berries, whole grains	Lignans
Cruciferous vegetables (broccoli, cabbage, kale)	Indoles
Cruciferous vegetables, especially broccoli	Isothiocyanates
Soybeans, other legumes, cucumbers, other fruits and vegetables	Phytosterols
Citrus fruit, onions, apples, grapes, red wine, tea, chocolate, tomatoes	Flavonoids
Soybeans, other legumes	Isoflavones
Tea	Catechins
Blueberries, strawberries, raspberries, grapes, apples, bananas, nuts	Polyphenols
Red, blue, and purple plants (blueberries, eggplant)	Anthocyanosides
Onions, bananas, oranges (small amounts)	Fructooligosaccharides
Grapes, peanuts, red wine	Resveratrol

Blueberries are rich in health-promoting phytochemicals. They have been shown to have anticancer effects and therefore could be an important part of dietary cancer prevention strategies. **What is your favorite way to incorporate phytochemicals into your daily menu?** Lifesize/Getty Images

noteworthy phytochemicals that are under study with their common food sources. Although there is not enough evidence to link individual phytochemicals with specific health benefits, there is enough proof to suggest that consuming phytochemical-rich foods and beverages may help prevent disease. Tomatoes are an important source of phytochemicals and are discussed in this chapter's "Farm to Fork" feature. ("Farm to Fork" appears in every chapter and presents practical information on how to grow, shop, store, and prepare various fruits and vegetables to obtain and preserve their flavor and nutrients.) More tips for boosting the phytochemical content of your diet are discussed in Chapter 2.

SOURCES OF NUTRIENTS

Now that we know the six classes of nutrients, it is important to understand the quantities of the various nutrients that people consume. On a daily basis, we consume about 500 grams, or about 1 pound, of protein, fat, and carbohydrate combined. In contrast, the typical daily mineral intake totals about 20 grams (about 4 teaspoons), and the daily vitamin intake totals less than 300 milligrams (1/15 of a teaspoon). Although we require a gram or so of some minerals, such as calcium and phosphorus, we need only a few milligrams or less of other minerals, such as zinc, each day.

FARM to FORK Tomatoes

Adrian Burke/Getty Images

Grow

- Naturally ripened tomatoes are more nutritious and flavorful than the artificially ripened tomatoes sold in supermarkets. Look for local tomatoes, including heirloom varieties, at nearby farmers' markets.
- Consider growing your own tomatoes, even in containers, to enjoy nutritious varieties harvested at the peak of ripeness.

Shop

- Choose tomatoes with the darkest red color for the most nutrients and highest amount of the phytochemical lycopene.
- Purchase smaller tomatoes for their sweetness and flavor, and the most lycopene and vitamin C.
- Buy processed tomato products, including jars or cans of paste and sauce, for their highly bioavailable lycopene.
- Choose tomato products in glass jars, aseptic-coated paper containers, or BPA-free cans. BPA, or bisphenol A, is a synthetic estrogen found in the coatings of some food cans, and has been linked to many health problems.

Store

- To preserve the flavor of fresh tomatoes, store them stem side up at room temperature. Flavor and aroma quickly decrease when tomatoes are stored in the refrigerator.
- Grape tomatoes should be stored in plastic clamshells (i.e., original packaging) to prevent them from drying out.
- Tomatoes are ripe and ready to eat when they are a deep color but still firm. Eat ripe tomatoes within two or three days.

Prep

- Use the whole tomato. The juice contains the flavor enhancer glutamate, and the skin and seeds provide vitamin C and lycopene.
- Snack on nutrition-packed grape tomatoes, and slice or chop them for salads, omelets, sandwiches, or tacos.
- Cooking tomatoes increases the bioavailability of nutrients and phytochemicals.
- Add tomato paste to recipes as a concentrated source of flavor, color, nutrients, and phytochemicals, with no added sugar or salt.

Source: Robinson J: Tomatoes: Bringing back their flavor and nutrients. In *Eating on the Wild Side*. New York: Little, Brown and Company, 2013.

Alfio Roberto Silvestro/123RF

The nutrient content of the foods we eat also differs from the nutrient composition of the human body. This is because growth, development, and later maintenance of the human body are directed by the genetic material (DNA) inside body cells. This genetic blueprint determines how each cell uses the essential nutrients to perform body functions. These nutrients can come from a variety of sources. Cells are not concerned about whether available amino acids come from animal or plant sources. The carbohydrate glucose can come from sugars or starches. The food that you eat provides cells with basic materials to function according to the directions supplied by the genetic material (genes) housed in body cells. Genetics and nutrition are discussed in Chapter 6.

CONCEPT CHECK 1.3

1. What are the six classes of nutrients?
2. What are the three general functions of nutrients in the body?
3. What are phytochemicals?

1.4 What Math Concepts Will Aid Your Study of Nutrition?

CALORIES

We obtain the energy we need for body functions and physical activity from various calorie sources: carbohydrates (4 kcal per gram), fats (9 kcal per gram), and proteins (4 kcal per gram). Foods generally provide more than one calorie source. Plant oils, such as soybean or canola oil, are one exception; these are 100% fat at 9 kcal per gram.

Alcohol is also a potential source of calories, supplying about 7 kcal per gram. It is not considered an essential nutrient, however, because it is not required for human function. Still, alcoholic beverages, such as beer—also rich in carbohydrate—are a contributor of calories to the eating patterns of many adults.

The body releases energy (measured in calories) from the chemical bonds in carbohydrate, protein, and fat (and alcohol) in order to:

- Build new compounds.
- Perform muscular movements.
- Promote nerve transmission.
- Maintain electrolyte balance within cells.

Chapter 7 describes how that energy is released from the chemical bonds in energy-yielding nutrients and then used by body cells to support the processes just described.

The energy in food is often expressed using the term *calories* on food labels. As defined earlier, a calorie is the amount of heat energy it takes to raise the temperature of 1 gram of water 1 degree Celsius (1°C, centigrade scale). A calorie is a tiny measure of heat relative to the amount of calories we eat and use. Food energy is more conveniently expressed in terms of the

Fullerene/Getty Images

WHOLE WHEAT BREAD

Nutrition Facts

19 servings per container

Serving size **1 slice (36g)**

Amount per serving

Calories **80**

	% Daily Value*
Total Fat 1g	**2**%
Saturated Fat 0g	**0**%
Trans Fat less than 1g	**
Cholesterol 0mg	**0**%
Sodium 200mg	**8**%

	% Daily Value*
Total Carbohydrate 15g	**5**%
Dietary Fiber 2g	**8**%
Total Sugars 3g	
Includes 2g Added Sugars	**4**%
Protein 3g	

Vitamin D 0mcg 0% • Calcium 30mg 3% • Iron 1mg 5% • Potassium 70mg 2%

* The % Daily Value (DV) tells you how much a nutrient in a serving of food contributes to a daily diet. 2,000 calories a day is used for general nutrition advice.

FIGURE 1-5 ▲ Use the nutrient values on the Nutrition Facts label to calculate calorie content of a food. Based on carbohydrate, fat, and protein content, a serving of this food (whole wheat bread) contains 81 kcal ([15 × 4] + [1 × 9] + [3 × 4] = 81). The label lists 80, suggesting that the calorie value was rounded down.

▲ Calorie content of energy nutrients and alcohol. The weights illustrate their relative energy potential per gram.

kilocalorie (kcal), which equals 1000 calories. (If the "c" in calories is capitalized, this also signifies kilocalories.) A kilocalorie is the amount of heat energy it takes to raise the temperature of 1000 grams (1 liter) of water 1°C. The abbreviation *kcal* is used throughout this book. On food labels, the word *calorie* (without a capital "C") is also used loosely to mean *kilocalorie.* Any values given on food labels in calories are actually in kilocalories (Fig. 1-5). A suggested intake of 2000 calories per day on a food label is technically 2000 kcal.

alcohol Ethyl alcohol or ethanol (CH_3CH_2OH) is the compound in alcoholic beverages.

CALCULATING CALORIES

The calorie estimates for carbohydrate, fat, protein, and alcohol (4-9-4-7) can be used to determine calorie content of a food. Consider these foods:

©Burke/Triolo/Brand X Pictures

1 Grilled Chicken Sandwich

Carbohydrate	46 grams × 4 = 184 kcal
Fat	14 grams × 9 = 126 kcal
Protein	45 grams × 4 = 180 kcal
Alcohol	0 gram × 7 = 0 kcal
Total	**490 kcal**

C Squared Studios/Getty Images

8-Ounce Piña Colada

Carbohydrate	57 grams × 4 = 228 kcal
Fat	5 grams × 9 = 45 kcal
Protein	1 gram × 4 = 4 kcal
Alcohol	23 grams × 7 = 161 kcal
Total	**438 kcal**

You can also use the 4-9-4 estimates to determine what portion of total kilocalorie intake is contributed by the various calorie-yielding nutrients. Assume that one day you consume 290 grams of carbohydrates, 60 grams of fat, and 70 grams of protein. This adds up to a total of 1980 kcal ([290 × 4] + [60 × 9] + [70 × 4] = 1980). The percentage of your total kilocalorie intake derived from each nutrient can then be determined:

% of kcal as carbohydrate	=	(290 × 4)	÷	1980	=	0.59 (× 100 = 59%)
% of kcal as fat	=	(60 × 9)	÷	1980	=	0.27 (× 100 = 27%)
% of kcal as protein	=	(70 × 4)	÷	1980	=	0.14 (× 100 = 14%)

Check your calculations by adding the percentages together. Do they total 100%?

PERCENTAGES

You will use a few mathematical concepts in studying nutrition. Besides performing addition, subtraction, multiplication, and division, you need to know how to calculate percentages and convert English units of measurement to metric units.

The term *percent* (%) refers to a part of the total when the total represents 100 parts. For example, if you earn 80% on your first nutrition examination, you will have answered the equivalent of 80 out of 100 questions correctly. This equivalent also could be 8 correct answers out of 10; 80% also describes 16 of 20 (16/20 = 0.80 or 80%). The decimal form of percents is based on 100% being equal to 1.00. It is difficult to succeed in a nutrition course unless you know what a percentage means and how to calculate one. Percentages are used frequently when referring to menus and nutrient composition. The best way to master this concept is to calculate some percentages. Some examples follow:

Question	Answer
What is 6% of 45?	6% = 0.06, so 0.06 × 45 = 2.7
What percent of 99 is 3?	3/99 = 0.03 or 3% (0.03 × 100)
Joe ate 15% of the adult Recommended Dietary Allowance for iron (RDA = 8 milligrams) at lunch. How many milligrams did he eat?	0.15 × 8 milligrams = 1.2 milligrams

THE METRIC SYSTEM

The basic units of the metric system are the meter, which indicates length; the gram, which indicates weight; and the liter, which indicates volume. Appendix F in this textbook lists conversions from the metric system to the English system (feet, pounds, and cups) and vice versa. Here is a brief summary:

A centimeter is 1/100 of a meter, 2.54 centimeters equals 1 inch.

A gram (g) is about 1/30 of an ounce (an ounce weighs 28 grams).

5 grams of sugar or salt is about 1 teaspoon.

A pound (lb) weighs 454 grams.

A kilogram (kg) is 1000 grams, equivalent to 2.2 pounds.

To convert weight in pounds to kilograms, divide it by 2.2.

A 154-pound man weighs 70 kilograms (154/2.2 = 70).

A gram can be divided into 1000 milligrams (mg) or 1,000,000 micrograms (µg or mcg).

10 milligrams of zinc (approximate adult need) would be a few grains of zinc.

Liters are divided into 1000 units called milliliters (ml); 100 milliliters is a deciliter (dl).

One teaspoon equals about 5 milliliters (ml), 1 cup is about 240 milliliters, and 1 quart (4 cups) equals almost 1 liter (L) (0.946 liter to be exact).

Examples:
You see on the label that a 5.3-ounce (oz) container of Greek yogurt contains 15 grams of sugar. How many teaspoons of sugar does this equal?

Answer: 15 grams ÷ 5 grams/teaspoon = 3 teaspoons of sugar in the 5.3-oz yogurt.

You are trying to drink at least 8 cups of water each day. You know 8 cups equals 64 ounces or 2 quarts of water because there are 8 ounces in a cup. Your water bottle, however, holds 500 milliliters (ml). How many milliliters or liters should you drink to equal 8 cups?

Answer: 8 cups × 240 ml/cup = 1920 ml = 1.92 liters (almost four 500 ml bottles).

If you plan to work in any scientific field, you will need to learn the metric system. In the field of nutrition, it is important to remember that a kilogram equals 2.2 pounds, an ounce weighs 28 grams, 2.54 centimeters equals 1 inch, and a liter is almost the same as a quart. In addition, know the fractions that the following prefixes represent: micro (1/1,000,000), milli (1/1000), centi (1/100), and kilo (1000).

☑ CONCEPT CHECK 1.4

1. What are the energy (kilocalorie) values for each of the "energy nutrients"?
2. If you weigh 154 pounds, what is your weight in kilograms?

1.5 How Do We Know What We Know About Nutrition?

The knowledge we have about nutrient needs comes from research. Like other sciences, the research that sets the foundation for nutrition knowledge has developed using the *scientific method,* a testing procedure designed to detect and eliminate error.

THE SCIENTIFIC METHOD

The first step of the scientific method is the observation of a natural phenomenon (Fig. 1-6). Scientists then suggest possible explanations, called **hypotheses,** for the phenomenon. At times, historical events have provided clues to important relationships in nutrition science, such as the link between the need for vitamin C and the development of the disease **scurvy** (see Chapter 8). Another approach is for scientists to study diet and disease patterns among various populations, a research method called **epidemiology.**

Thus, hypotheses about the role of diet in various health problems can be suggested by historical and epidemiological findings. *Proving* the role of particular dietary components, however, requires controlled experiments. The data gathered from experiments may either support or refute each hypothesis. If the results of many experiments support a hypothesis, scientists accept the hypothesis as a **theory.** Often, the results from one experiment suggest a new set of questions.

The most rigorous type of controlled experiment follows a study design that is randomized, **double-blind,** and placebo controlled. In this type of study, a group of participants—the experimental group—follows a specific protocol (e.g., consuming a certain food or nutrient), and participants in a corresponding **control group** follow their normal habits or consume a **placebo.** People are randomly assigned to each group. Scientists then observe the experimental group over time to see if there is any effect not found in the control

hypotheses Tentative explanations by a scientist to explain a phenomenon.

scurvy The vitamin C deficiency disease characterized by weakness, fatigue, slow wound healing, bone pain, fractures, sore and bleeding gums, diarrhea, and pinpoint hemorrhages on the skin.

epidemiology The study of how disease rates vary among different population groups.

theory An explanation for a phenomenon that has numerous lines of evidence to support it.

double-blind study An experimental design in which neither the participants nor the researchers are aware of each participant's assignment (test or placebo) or the outcome of the study until it is completed. An independent third party holds the code and the data until the study has been completed.

control group Participants in an experiment who are not given the treatment being tested.

placebo Generally, an inactive medicine or treatment used to disguise the treatments given to the participants in an experiment.

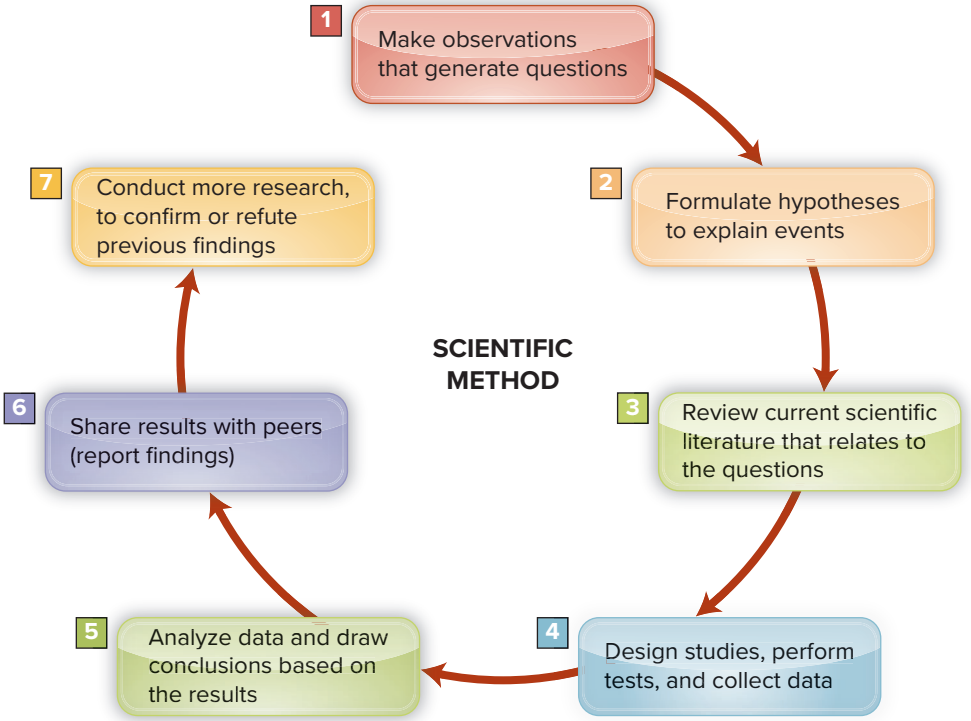


FIGURE 1-6 ▲ The scientific method. Scientists consistently follow these steps when testing all types of hypotheses. Scientists do not accept a nutrition or other scientific hypothesis until it has been thoroughly tested using the scientific method.

case-control study A study in which individuals who have a disease or condition, such as lung cancer, are compared with individuals who do not have the condition.

group. A **case-control study** compares individuals who have a disease or condition, such as lung cancer, to individuals who do not have the condition. Figure 1-6 shows how the scientific method is used to test a hypothesis.

TYPES OF EXPERIMENTS

Human experiments provide the most convincing evidence about relationships between nutrients and health, but they are often not practical or ethical to conduct. Thus, much of what we know about human nutritional needs and functions has been gleaned from animal experiments. The use of animal experiments to study the role of nutrition in certain human diseases depends on the availability of an **animal model** in which a disease in laboratory animals closely mimics a particular human disease. Often, if no animal model is available and human experiments are ruled out, scientific knowledge cannot advance beyond what can be learned from epidemiological studies.

animal model Use of animals to study disease to understand more about human disease.

Once an experiment is complete, scientists summarize the findings and seek to publish the results in scientific journals. Generally, before articles are published in scientific journals, they are critically **peer reviewed** by other scientists familiar with the subject, which helps to ensure that only high-quality, objective research findings are published. Peer review occurs between steps 5 and 6 in Figure 1-6.

peer review Evaluation of work by professionals of similar competence (peers) to the producers of the work to maintain standards of quality and credibility. Scholarly peer review is used to determine if a scientific study is suitable for publication.

Keep in mind that one experiment is never enough to prove a particular hypothesis or provide a basis for nutritional recommendations. Rather, through follow-up studies, the results obtained in one laboratory must be confirmed by similar experiments conducted in other laboratories and, possibly, under varying circumstances. Only then can we really trust and use the results. As shown in Figure 1-7, the more lines of evidence available to support an idea, the more likely it is to be true.

Epidemiological studies may suggest hypotheses, but controlled experiments are needed to rigorously test hypotheses before nutrition recommendations can be made.

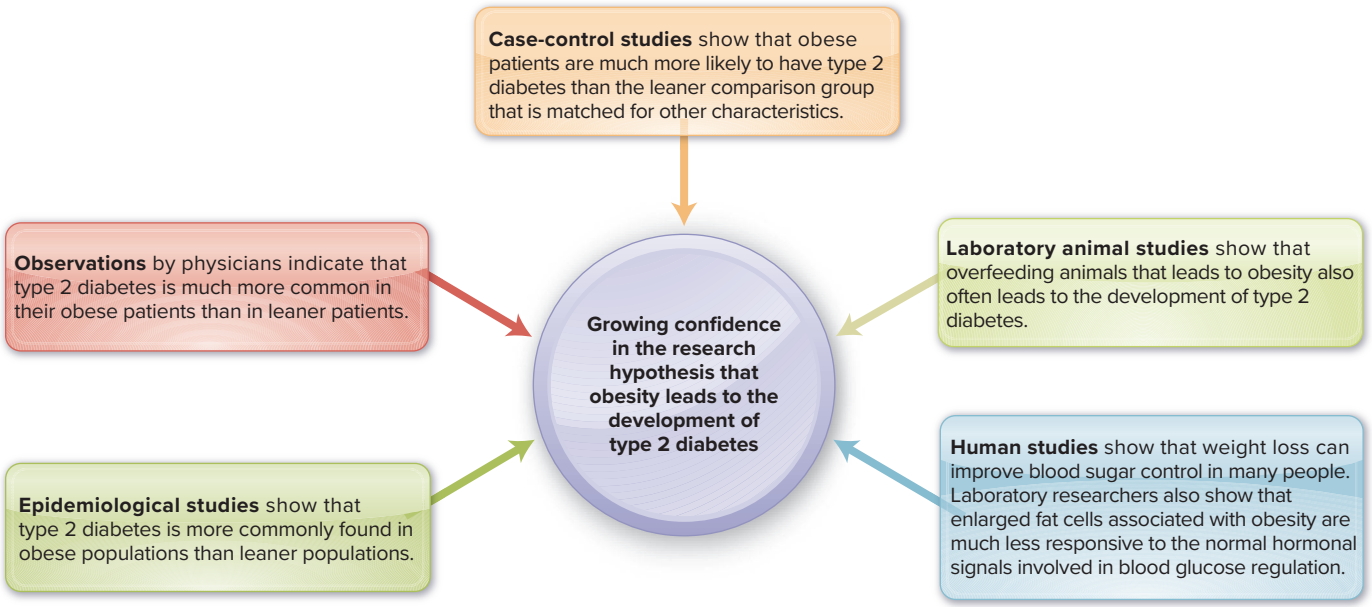


FIGURE 1-7 ▲ Data from a variety of sources can come together to support a research hypothesis. This diagram shows how various types of research data support the hypothesis that obesity leads to the development of type 2 diabetes.

For example, epidemiologists found that smokers who regularly consumed fruits and vegetables had a lower risk for lung cancer than smokers who ate very few fruits and vegetables. Scientists proposed that beta-carotene, a pigment present in many fruits and vegetables, may be responsible for reducing the damage caused by tobacco smoke in the lungs. They hypothesized that providing dietary supplements of beta-carotene would reduce the risk of lung cancer. However, in double-blind studies of heavy smokers, the risk of lung cancer was *higher* for those who took beta-carotene supplements than for those who did not (this is not true for the small amount of beta-carotene found naturally in foods). Soon after these results were reported, two other large federally funded studies using beta-carotene supplements were stopped on the basis that these supplements are ineffective in preventing both lung cancer and cardiovascular disease.

Newsworthy Nutrition

Throughout this textbook, we have highlighted the use of the scientific method in research studies in the feature "Newsworthy Nutrition." These are recently published studies that relate to chapter topics and that have made a significant impact on our nutrition knowledge. You will find the first "Newsworthy Nutrition" study in Section 1.6 on the current state of North American eating patterns and health.

✓ CONCEPT CHECK 1.5

1. What are the seven steps used in the scientific method?
2. Name the various types of research studies that can be done to test a hypothesis.

1.6 What Is the Current State of North American Eating Patterns and Health?

DOES OBESITY THREATEN OUR FUTURE?

There is no doubt that the obesity epidemic threatens the future health of Americans. It is estimated that 39.8% of adults were obese in 2015–2016, with *obesity* defined as having an excessive amount of body fat relative to lean tissue. Considered more broadly, two-thirds of adults and one-third of children are overweight or obese (these terms will be defined numerically in Chapter 7). According to the Centers for Disease Control and Prevention (CDC), in 2015–2016 the average American adult man weighed 197.9 pounds, and the average American adult woman weighed 170.6 pounds. Where you live

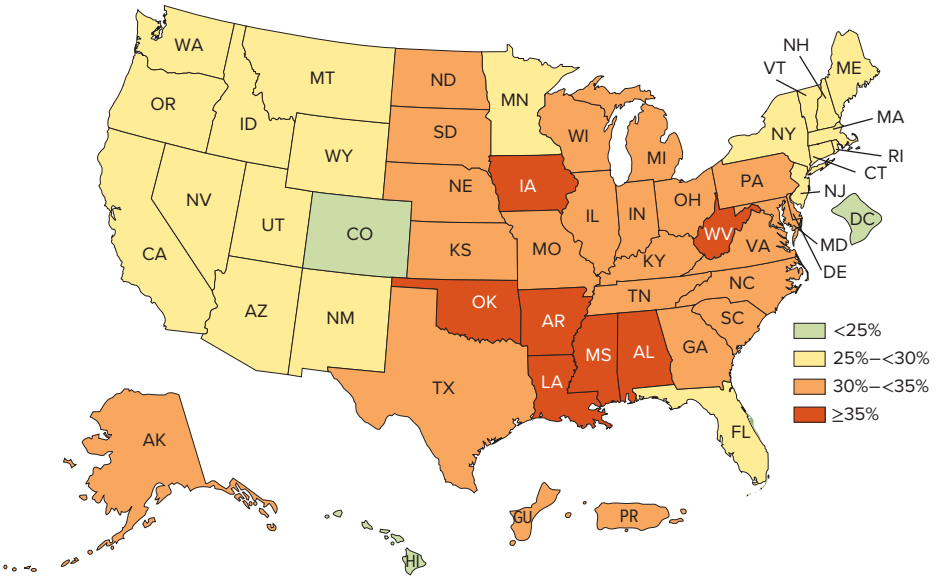


FIGURE 1-8 ▲ Percentage of adults who are obese,* by state, 2017.

Source: CDC, Prevalence of Self-Reported Obesity Among U.S. Adults by State and Territory, BRFSS, 2017.

*Body mass index (BMI) > 30, or about 30 pounds overweight for a 5′9″ person, based on self-reported weight and height.

is also a factor, with obesity rates varying by state. State by state, self-reported obesity data from the CDC (Fig. 1-8) indicate that in 2017, 22 states had an adult obesity rate of 30% to less than 35% and 7 states (Alabama, Arkansas, Iowa, Louisiana, Mississippi, Oklahoma, and West Virginia) had the highest adult obesity rates—over 35%. In 2017, most states with the lowest obesity rates were in the Northeast or the West, and the South and the Midwest had the highest prevalence of obesity.[8] In 2006, only one state was above 30%.

All the data from national surveys indicate that the adult obesity rate has been rising for decades. Although obesity rates held at around 34% and 35% between 2005 and 2012, the most recent data show the rates approaching 40%. There is work being done, however, to help combat these obesity trends. The annual *State of Obesity* reports have documented how policies and programs at the local, state, and federal levels have helped Americans eat healthier.[9] Read more about obesity rates in the "Newsworthy Nutrition" feature in this section.[10]

It is well documented that this extra weight will continue to have dangerous consequences. In Section 1.2, we pointed out that obesity plays a role in chronic illness, including heart disease, stroke, high blood pressure, high cholesterol, diabetes, arthritis, and certain cancers. It is estimated that obesity kills more than 200,000 Americans each year. Because of its role in so many chronic disorders, obesity is an expensive condition, with more than $190 billion spent annually on health care related to obesity. Because of numerous medical conditions, obese individuals are absent from work more often than those of healthy weight. Health economists estimate that obesity-related absenteeism costs employers as much as $6.4 billion a year, whereas loss of on-the-job productivity due to pain, shortness of breath, or other obstacles costs another $30 billion. It has become obvious that the answers to the obesity crisis are not simple. From a nutrition perspective, however, the problem can be clearly stated. Most of us continue to eat too much, especially foods with a high number of calories and a low number of nutrients, and we do not engage in enough physical activity.

Newsworthy Nutrition

No decrease in adult obesity rates from 2005 to 2014

INTRODUCTION: The prevalence of obesity in the United States is high, with 39.8% of adults estimated to be obese. Despite its high occurrence, an earlier study found that the prevalence of obesity for men and women remained stable between 2003 and 2012. Because of this leveling-off rate, scientists at the National Center for Health Statistics developed a hypothesis that the prevalence of obesity in adults would also have remained stable between 2005 and 2014. **OBJECTIVES:** The purpose of this study was to analyze trends in adult obesity between 2005 and 2014. **METHODS:** The analyses were based on measurements of weight and height in 5455 adults from the 2013–2014 National Health and Nutrition Examination Survey (NHANES) and from 21,013 participants in previous NHANES surveys from 2005 through 2012. **RESULTS:** For the years 2013–2014, the overall prevalence of obesity was 37.7%; 35.0% of men were obese (BMI ≥ 30), and 5.5% were morbidly obese (BMI ≥ 40); among adult women, 40.4% were obese, and 9.9% were morbidly obese. These obesity rates were unchanged over the decade from 2005 through 2014 among men, but there were significant increases among women for overall obesity and for morbid obesity. **CONCLUSIONS:** Based on these results, the authors of this study conclude that other studies are needed to determine the causes of the increases in obesity prevalence.

Source: Flegal KM and others: Trends in Obesity Among Adults in the United States, 2005 to 2014. *Journal of the American Medical Association* 351:2284, 2016.

▲ From 2005 to 2014, obesity rates were unchanged for men but increased for women. ©Maria Dryfhout/Cutcaster

ASSESSING THE CURRENT NORTH AMERICAN EATING PATTERN

With the aim of finding out what North Americans eat, federal agencies conduct surveys to collect data about food and nutrient consumption, as well as connections between diet and health. In the United States, the U.S. Department of Health and Human Services monitors food consumption with the National Health and Nutrition Examination Survey. The NHANES was used in the study highlighted in the "Newsworthy Nutrition" feature. In Canada, this information is gathered by Health Canada in conjunction with Agriculture and Agrifood Canada. Survey data from 2013–2014 indicate that North American adults consume about 16% of their calorie intake as proteins, 48% as carbohydrates, 34% as fats, and 3% as alcohol. These percentages fall within the ranges recommended by the Food and Nutrition Board (FNB) of the National Academy of Sciences. The FNB advocates that 10% to 35% of calories come from protein, 45% to 65% from carbohydrate, and 20% to 35% from fat. These standards apply to people in both the United States and Canada.

Food-consumption data also indicate that about two-thirds of protein intake is from animal sources for most North Americans, whereas plant sources supply only about one-third. In many other parts of the world, it is just the opposite: plant proteins—from rice, beans, corn, and other grains and vegetables—dominate protein intake. About half the carbohydrate in North American diets comes from simple sugars; the other half comes from starches (such as in pastas, breads, and potatoes). About 60% of dietary fat comes from animal sources and 40% from plant sources.

Evidence of positive changes in eating patterns have begun to appear. Results from the recent NHANES show that calories consumed daily by the typical U.S. adult are declining for the first time in over 40 years. One of the most significant declines has been in the amount of sugar-sweetened soda consumed. Keep in mind that while these changes in calories consumed are a step in the right direction and appear to stem from

▲ Although positive changes in eating habits have begun, about half the carbohydrates that North Americans consume come from simple sugars; and the other half come from starches in foods such as pastas, breads, and potatoes. Two-thirds of protein consumption is from animal sources such as the burgers, cheese, and hot dogs shown in this pile of "junk" food. mphillips007/iStockphoto/Getty Images

our growing awareness of the dangers of eating and drinking too much, we often do not choose the foods that will meet all our nutrient needs.

In the next section, we discuss recommendations to consume a variety of nutrient-dense foods within and across the food groups, especially whole grains, fruits, vegetables, low-fat or fat-free milk or milk products, and lean meats and other protein sources. These foods will provide nutrients that are often overlooked, including various vitamins, minerals, fiber, and many phytochemicals. Daily intake of a balanced multivitamin and mineral supplement is another strategy to help meet nutrient needs but does not make up for a poor eating pattern. Also keep in mind that use of nutrient supplements should be discussed with your health professional to avoid potentially harmful side effects (dietary supplements are discussed in Chapter 8).

Experts also recommend that we pay more attention to balancing calorie intake with needs. An excess intake of calories is usually tied to overindulgence in sugar, fat, and alcoholic beverages. Many North Americans would benefit from a healthier balance of food in their eating patterns. Moderation is the key for some foods that are high in calories from sugar and fat. For other foods, such as fruits and vegetables, increased quantity and variety are warranted. Few adults currently meet the recommendation to "fill half your plate with fruits and vegetables" promoted by many health authorities.

HEALTH OBJECTIVES FOR THE UNITED STATES

Health promotion and disease prevention have been public health strategies in North America for the past 3 decades. Every 10 years, the U.S. Department of Health and Human Services' (DHHS) Public Health Service issues a collection of health objectives for the nation. These objectives are developed by experts in federal agencies and target major public health concerns, setting goals for the coming decade. *Healthy People 2020* sets forth more than 600 health objectives across 42 topic areas and outlines national standards to eliminate health disparities, improve access to health education and quality health care, and strengthen public health services. Important features of *Healthy People 2020* include a focus on creating social and physical environments that promote good health for all. An interactive, personalized website is available at www.HealthyPeople.gov.

The overarching goals of *Healthy People 2020* are to:

▲ An increase in the consumption of some foods, such as fruits and vegetables, can lead to a healthier balance of food in the North American eating pattern. xefstock/ Getty Images

- Attain high-quality, longer lives free of preventable disease, disability, injury, and premature death.
- Achieve health equity, eliminate disparities, and improve health of all groups.
- Create social and physical environments that promote good health for all.
- Promote quality of life, healthy development, and healthy behaviors across all life stages.

Healthy People 2020 includes a specific nutrition topic area called Nutrition and Weight Status, and its objectives target individual behaviors, as well as the policies and environments that support these behaviors. These objectives are important because a healthful diet helps us reduce our risks for numerous health conditions that burden the public health system, including heart disease, high blood pressure, diabetes, osteoporosis, and some cancers. Good nutrition for children is also emphasized in this report because of its importance for growth and development. Generally, the Nutrition and Weight Status objectives aim to reduce risks for obesity and chronic diseases, increase household food security, and eliminate hunger.

The Nutrition and Weight Status objectives are based on strong science that supports the health benefits of eating a healthful diet and maintaining a healthy body weight. A healthful diet is described as one that includes:

- Consuming a variety of nutrient-dense foods within and across the food groups, especially whole grains, fruits, vegetables, low-fat or fat-free milk or milk products, and lean meats and other protein sources.
- Limiting intake of solid fats, cholesterol, added sugars, sodium (salt), and alcohol.
- Limiting caloric intake to meet caloric needs.

The objectives also emphasize that individual behaviors should be addressed in any efforts to change diet and weight, as well as the policies and environments that support these behaviors in settings such as schools, work sites, health care organizations, and communities. Although some of the Nutrition and Weight Status objectives have been met or improved, there has been little or no detectable change for several of them. Work has begun on *Healthy People 2030,* which will be the fifth edition of *Healthy People. Healthy People 2030* aims at new challenges and builds on lessons learned from its first four decades.

☑ CONCEPT CHECK 1.6

1. Surveys indicate that we could improve our diets by increasing which types of food sources?
2. The consumption of which types of foods should be reduced to attain and maintain good health?

1.7 What Can You Expect from Good Nutrition and a Healthy Lifestyle?

The obesity epidemic and prevalence of chronic diseases in the United States show that something is not right with many of our eating patterns and/or lifestyles. The strong association between obesity and poor health is clear. The reverse is also well documented: when an overweight person loses just 5% to 10% of body weight, that person's risks of many chronic diseases are greatly reduced.

HEALTHY WEIGHT

Because weight gain is one of the greatest lifelong nutrition challenges, we encourage you to seek a lifestyle that will make gaining weight more difficult and maintaining a healthy weight easier. Preventing obesity in the first place is the easiest approach. Unfortunately, many aspects of our society make it hard not to gain weight. The earlier (preferably in childhood) we develop lifestyle habits of good nutrition, regular physical activity, and the avoidance of addictions to salt, fat, sweets, high-calorie foods, and sedentary lifestyles, the better our chances for a long, healthy life. Aim to live in a city or town that has opportunities for physical activity such as bike paths, walking trails, and parks, as well as access to fresh fruits and vegetables through farmers' markets and community gardens. Seek out and join running or walking clubs. Shop at grocery stores that offer a good selection of fruits, vegetables, and other healthy foods. When dining out, choose restaurants that have tasty but healthy options on their menu.

Fortunately, many eating habits have improved during the past decade. Today, we can choose from a wide variety of food products as a result of continual innovation by food manufacturers. Our cultural diversity, varied cuisines, and general lack of nutrient deficiencies should be points of pride for North Americans.

▲ Access to fresh fruits and vegetables through farmers' markets and community gardens is important to a healthy lifestyle. Mary-Jon Ludy/McGraw-Hill Education

▲ Regular physical activity complements a healthy diet. Whether it is all at once or in segments throughout the day, incorporate 30 to 60 minutes or more of such activity into your daily routine. Monkey Business Image/age fotostock

LONGER, HEALTHIER LIVES

Today, North Americans live longer than ever and enjoy better general health, partly because of better medical care and dietary patterns. Affluence, however, has also led to sedentary lifestyles and high intakes of animal fat, salt, and alcohol. This lifestyle pattern has led to problems such as cardiovascular disease, hypertension, diabetes, and, of course, obesity. Greater efforts are needed by the general public to lower intake of animal fats and to improve variety in our diets, especially from fruits, vegetables, and whole grains. With better technology and greater choices, we can have a much healthier eating pattern today than ever before—if we know what choices to make!

THE TOTAL DIET

Nutrition experts generally agree that there are no "good" or "bad" foods, but some foods provide relatively few nutrients in comparison to calorie content. In Chapter 2, you will learn that an individual's total diet is the proper focus in a nutritional evaluation. Health experts have prepared many reports and outlined numerous objectives to get us closer to being a "Healthy People." In Chapter 2, we will discuss the "Dietary Guidelines for Americans" that are published every 5 years and the interactive programs available on **ChooseMyPlate.gov.** As you reexamine your nutritional habits, remember your health is largely your responsibility. Your body has a natural ability to heal itself. Offer it what it needs, and it will serve you well. Confusing and conflicting health messages hinder change in our eating patterns.

Prevention of disease is an important investment of one's time, even during the college years. The following recommendations will help promote your health and prevent chronic diseases: (1) consume enough essential nutrients, including fiber, while moderating energy, solid fat, added sugar, and alcohol intake; (2) do adequate, regular physical activity (at least 30 to 60 minutes on most or all days); (3) minimize alcohol intake (no more than two drinks per day for men and one drink for women); and (4) do not smoke tobacco cigarettes or cigars. In addition to these recommendations, you can optimize your health by getting adequate sleep (7 to 9 hours per night), consuming sufficient water (9 to 13 cups per day from foods and beverages), reducing stress, using medications prudently, and, of course, abstaining from use of illicit drugs. Section 1.8 gives you a "sneak peek" at several nutrition issues relevant to most college students. These issues, including the "freshman 15," vegetarianism, fuel for athletes, eating disorders, and alcohol and binge drinking, also will be covered more fully in later chapters of the book.

☑ CONCEPT CHECK 1.7

1. What are some eating patterns, physical activities, and lifestyle recommendations for health promotion and disease prevention?

ASK THE RDN Who's the Expert?

Dear RDN: *I am interested in making positive changes to my eating pattern to reach a healthy weight and feel better. How can I find a qualified nutrition expert who will give me personalized nutrition advice?*

You have already made a big step toward better nutrition by taking this nutrition course! The information in this textbook is written by authors who are all qualified nutrition experts, namely *registered dietitian nutritionists* (RDN). The textbook and your instructor will provide a solid foundation in nutrition, but be aware that some people call themselves "nutritionists" without qualified training in nutrition. The best approach to finding answers about your personal nutritional state is to consult your primary care provider, **registered dietitian (RD),** or **registered dietitian nutritionist (RDN).** The RD/RDN has been certified by the Commission on Dietetic Registration of the Academy of Nutrition and Dietetics (Academy) after completing rigorous classroom and clinical training in nutrition. The RD/RDN must also complete continuing education. The RD credential was recently updated to RDN to better reflect the scope of practice of dietitians. While both titles signify the same credential, we will use RDN when referring to dietitians in this book.

You can begin your search for a local RDN by asking your instructor, primary care provider, or health insurance company for a referral. You can also find an RDN by using the Academy national referral service, called *Find a Registered Dietitian Nutritionist.* This service links consumers with qualified nutrition practitioners who are members of the Academy and provide reliable, objective nutrition information. Visit the Academy's website, www.eatright.org, and click on "Find an Expert." (In Canada, visit the Dietitians of Canada website, www.dietitians.ca, and click on "Find a Dietitian.") Enter your zip code or state to display the providers in your area. Select additional specialties that may apply to your specific needs. The website will display a list of providers. A professional with the RD or RDN credential after his or her name is a qualified nutrition expert who is trained to help you separate facts from fads and optimize your health with better food choices. You can trust an RDN to translate the latest scientific findings into easy-to-understand nutrition information.

We will use this feature, "Ask the RDN," in every chapter to answer questions about topics that may seem to have conflicting viewpoints.

Your nutrition expert,

Anne M. Smith, PhD, RDN, LD

©Monty Soungpradith/ Open Image Studio LLC

registered dietitian (RD) A person who has completed a baccalaureate degree program approved by the Accreditation Council for Education in Nutrition and Dietetics (ACEND), performed at least 1200 hours of supervised professional practice, passed a registration examination, and complies with continuing education requirements.

registered dietitian nutritionist (RDN) The RDN is the updated credential formerly abbreviated RD. The credential was updated to better reflect the scope of practice of the dietitian and to align with the new name of the professional organization for dietitians, the Academy of Nutrition and Dietetics.

◀ An RD or RDN is a qualified nutrition expert trained to help you separate facts from fads and to optimize your health with better food choices. You can trust an RDN, like this supermarket dietitian, to translate the latest scientific findings into easy-to-understand nutrition information.
Hero Images/Getty Images

1.8 Nutrition and Your Health

Eating Well as a Student

Fancy Collection/SuperStock

Whether you are a traditional college student or a returning student balancing school, work, and family, studies show that the eating patterns of college students are not optimal. Typically, students fall short of nutrition recommendations for whole grains, vegetables, fruits, milk, and meat, opting instead to max out on fats, sweets, and alcohol. This information is disturbing because students are forming many health behaviors that will persist throughout life.

What is it about the student lifestyle that makes it so difficult to build healthy habits? In this section, we discuss several topics and provide possible solutions.

Food Choices

For traditional college students, these years are a time for freedom and a chance to make personal lifestyle decisions. College students face changes in academic requirements, interpersonal relationships, and living environments. For all types of students taking college courses, these stressful situations contribute to poor health behaviors. For example, when you are writing papers and cramming for exams, balanced meals are all too easily replaced by high-fat and high-calorie fast foods, convenience items, and sugary, caffeinated beverages. Physical activity is sacrificed in favor of study time. In a recent study of college students living on and off campus, two-thirds of the students reported skipping meals, with "no time to prepare" the major reason for this behavior.[11]

Also consider that when on campus you are faced with a wide variety of dining choices. Dining halls, fast-food establishments, bars, and vending machines combine to offer food 24 hours per day. While it is certainly possible to make wise food choices at each of these outlets, the temptations of convenience, taste, and value (i.e., inexpensive, oversized portions) may persuade the college student to select unhealthy options.

Meals and snacks are also times to socialize. You may unintentionally eat a big lunch at noon without regard to hunger if your classmates are meeting in the dining hall or food court to catch up. While chatting, it is easy to lose track of portions and to overeat. In addition, food may be a source of familiarity and comfort in a new and stressful place.

Weight Control

Studies show that most college students gain weight during their first year.[12, 13] The *freshman 15* is a term used to describe the weight gained by students during their first year of college. Although it is becoming evident that most freshmen actually do not gain the 15 pounds, a recent study of over 7000 U.S. college students found that students pack on 2.4 to 3.5 pounds on average during their first year away from home.[14] Very few (just under 10%) freshmen gained 15 pounds or more, and 25% of freshmen actually lost weight. The research also determined cumulative weight gain over all of the years at college and found that women gained approximately 9 pounds and men 13 pounds, on average. The two lifestyle factors that made a difference in weight gain among the students were heavy drinking and working during college.

There are several reasons to maintain a healthy weight. Over the long term, risk of chronic diseases goes up as weight increases. In the short term, losing excess weight can improve how you feel and perform. Detecting "flab" around your midsection or feeling that your clothes are getting tighter are two good indicators that you are carrying excess weight. If weight loss is necessary, you can safely lose excess pounds with some knowledge and perseverance.

Behavioral research clearly demonstrates that setting several small, achievable goals will spur motivation. As you will learn in Chapter 7, body weight is a balancing act between calories in and calories burned. Try keeping track of your calorie consumption for several days and comparing that to your energy needs, based on your age, gender, and activity level. You can use the NutritionCalc Plus application in Connect® for this text to estimate your energy needs.

A healthy rate of weight loss is 1 to 2 pounds per week. Greater rates of weight loss will not likely be sustained over time. Remember that the numbers on the scale are not as important as your body composition—the amount of fat in relation to lean mass. In order to lose weight, you must create an energy deficit, either by restricting energy intake below what you need to maintain your current weight or by increasing your physical activity. For an adult with excess weight, an energy deficit of 500 kcal per day will result in weight loss of about 25 pounds over a year's time. As weight is lost, energy needs gradually decrease, such that further deficits will be required to lose additional weight.

CASE STUDY College Student Eating Habits

Andy is like many other college students. He grew up on a quick bowl of cereal and milk for breakfast and a hamburger, French fries, and cola for lunch, either in the school cafeteria or at a local fast-food restaurant. At dinner, he generally avoided eating any of his salad or vegetables, and by 9:00 P.M. he was deep into bags of chips and cookies. Andy has taken most of these habits to college. He prefers coffee for breakfast and possibly a chocolate bar. Lunch is still mainly a hamburger, French fries, and cola, but pizza and tacos now alternate more frequently than when he was in high school. One thing Andy really likes about the restaurants surrounding campus is that, for a few cents more, he can make his hamburger a double or get extra cheese and pepperoni on his pizza. This helps him stretch his food dollar; searching out large-portion value meals for lunch and dinner has become part of a typical day. Now that he is in college, some of Andy's calories come from alcohol. He will have a beer with dinner a couple nights a week and will binge on a six-pack or more while tailgating before Saturday football games.

▲ Now that he is a college student, Andy could use some advice on developing a healthy, adult eating pattern. Dinodia Photos/Alamy

Provide Andy some advice about his eating pattern. Start with his positive habits and then provide some constructive criticism, based on what you now know.

Answer the following questions, and as you make suggestions for Andy, think about your favorite food choices, why they are your favorites, and whether these are positive choices.

1. Recalling Section 1.1 and Figure 1-1, list the factors that are influencing Andy's current food choices.
2. **Start with Andy's positive habits:** What healthy choices are being made when Andy eats at local restaurants?
3. **Now provide some constructive criticism:**
   a. What are some of the negative aspects of items available at fast-food restaurants?
   b. Why is ordering the "value meals" a dangerous habit?
   c. What healthier substitutions could he make at each meal?
   d. List some healthier choices he could make at fast-food restaurants on campus.
   e. What concerns would you share about Andy's weekly alcohol intake?

Complete the Case Study. Responses to these questions can be provided by your instructor.

Although many students skip it, breakfast is the *most* important meal of the day. Starting the day off with a serving of lean protein (e.g., an egg, Canadian bacon, Greek yogurt, or protein shake), a fortified whole grain breakfast cereal, skim milk, and a serving of fruit puts you on the right path for meeting recommendations for fiber, calcium, and fruit intake. Even though it may seem that coffee gets your brain going in the morning, your brain is fueled best by carbohydrates, not caffeine. Studies also show that eating breakfast may prevent overeating later in the day. Read more about the best breakfast choices in the "What the Dietitian Chose" recommendations at the end of this chapter.

▲ Research has shown that gourmet coffee beverages, such as lattes and cappuccinos, can increase calorie consumption by about 200 kcal per day. ©BananaStock/PunchStock

▶ Five Simple Tips to Avert Weight Gain

- **Eat breakfast.** Rev up your metabolism with a protein source such as an egg or Greek yogurt, at least one serving of whole grains such as a breakfast cereal, and a fruit such as a banana.
- **Plan ahead.** Eat a balanced meal or snack every 3 to 4 hours.
- **Limit liquid calories.** Drink water instead of high-calorie soft drinks, fruit juice, alcohol, or coffee; if you drink alcohol, limit it to no more than two drinks per day for men and one drink per day for women.
- **Stock the fridge and pantry.** Keep a stash of low-calorie, nutritious snacks such as string cheese, pretzels, light microwave popcorn, and fruit (fresh, canned, or dried).
- **Exercise regularly.** Find a friend to work out with you. Experts recommend 30 minutes of moderate exercise at least 5 days a week.